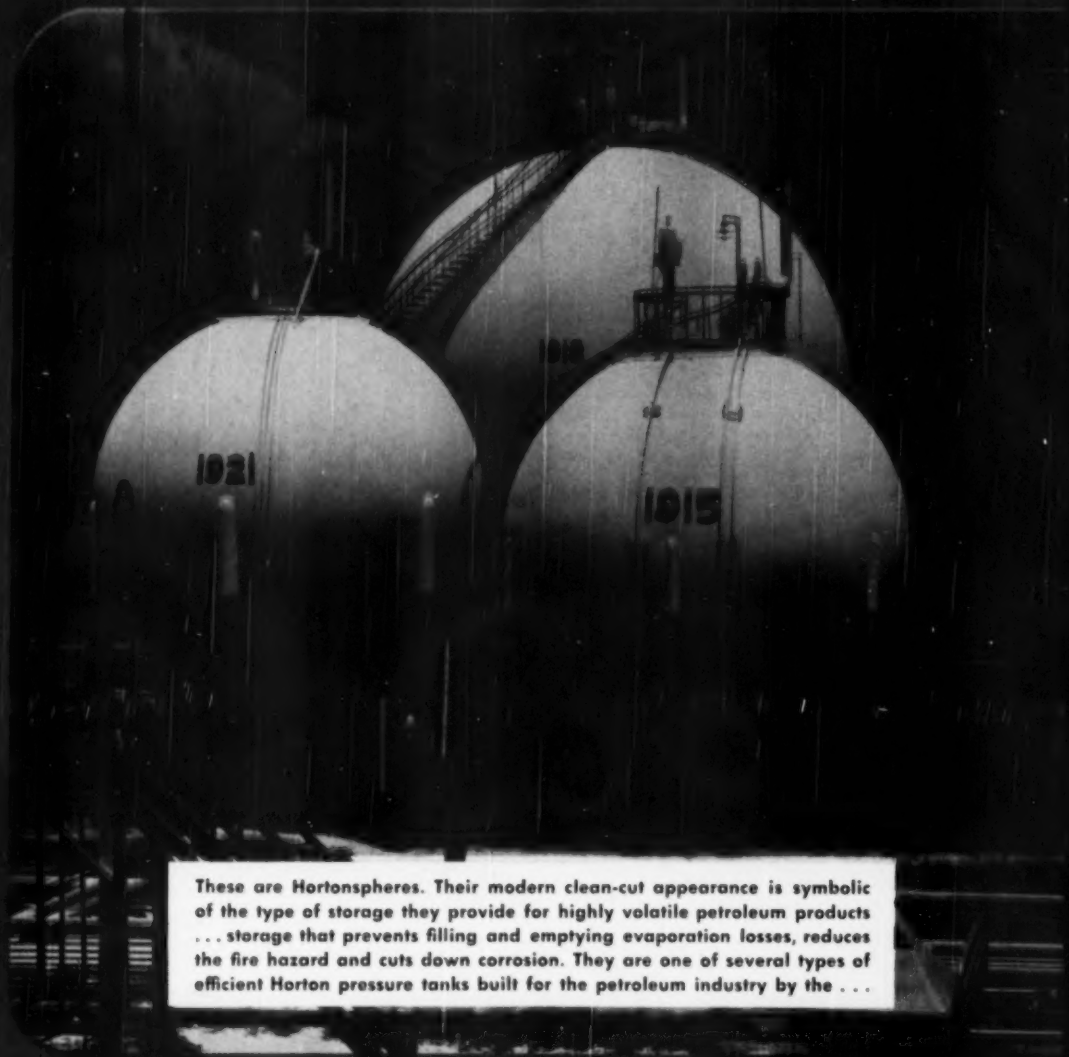
APRIL, 1950

PETROLEUM REFINER

SPECIALIZED FOR REFINING, NATURAL GASOLINE AND PETRO-CHEMICAL ENGINEERING, OPERATION AND MANAGEMENT



These are Hortonspheres. Their modern clean-cut appearance is symbolic of the type of storage they provide for highly volatile petroleum products . . . storage that prevents filling and emptying evaporation losses, reduces the fire hazard and cuts down corrosion. They are one of several types of efficient Horton pressure tanks built for the petroleum industry by the . . .

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Nest of Yarway traps installed with Yarway Strainers on cloth dryer. Note small space required.

Stainless Steel Body

YARWAY IMPULSE STEAM TRAP

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for the drilling-producing-pipe line industry

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R. L. DUDLEY, President — A. L. BURNS, General Manager

VOLUME 29, No. 4 — APRIL, 1950

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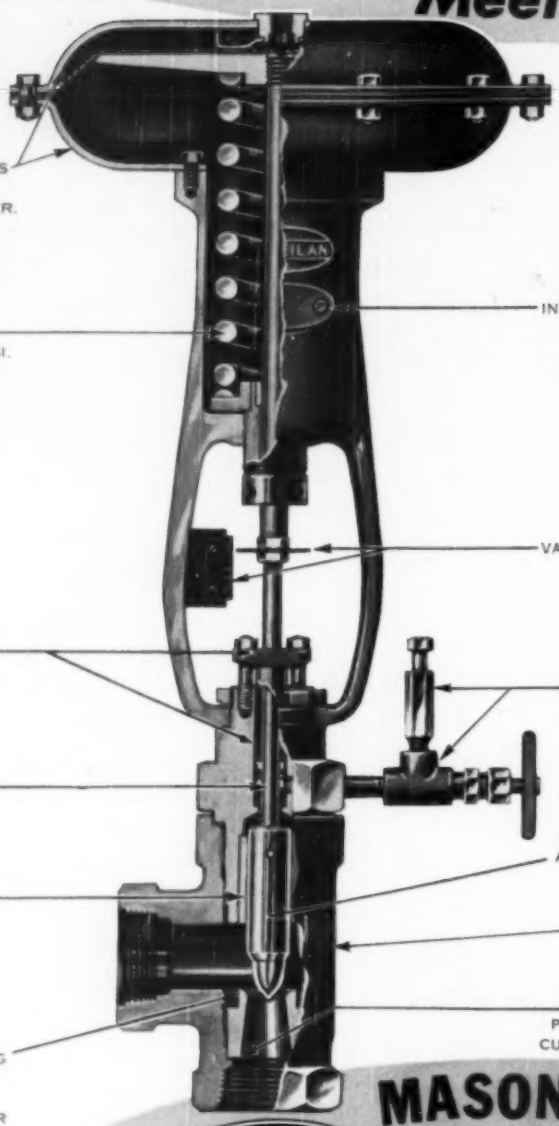

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Material — Stainless steel plug, seat ring, plug stem, guide bushing and lubricant ring.
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Diaphragm — neoprene or rubber.

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¼" pressure lubricator with forged steel isolating valve.

AIR-FIN BONNET

Available — not standard.

SPRING RANGES

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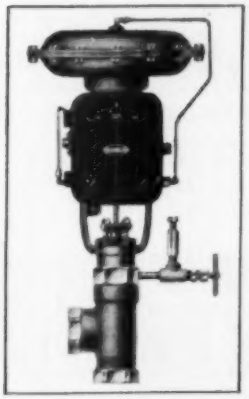
6–30 psi available.



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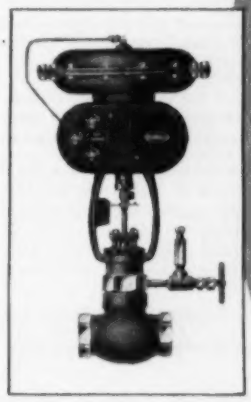
No. 137-5
Control Valve



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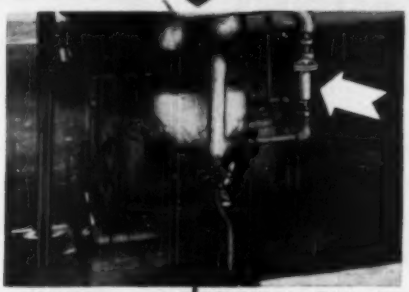
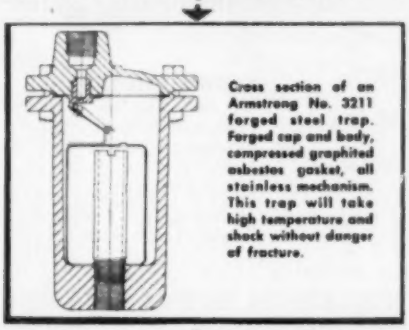


SAFETY . . . DEPENDABILITY



Cross section of an Armstrong No. 3211 forged steel trap. Forged cap and body, compressed graphited asbestos gasket, all stainless mechanism. This trap will take high temperature and shock without danger of fracture.

SMALL SIZE . . . LIGHT WEIGHT

NOW, for many applications, refineries and natural gasoline plants can have the additional safety of a forged steel steam trap for only a few dollars more than a cast iron trap of comparable size. The Armstrong No. 3211 trap illustrated will withstand fire or explosion without danger of fracture. It is the baby of the Armstrong forged steel line, a low priced trap for working pressures up to 250 psi; design pressure, 450 psi. Capacity range 750 to 1000 lbs/hr continuous. ½" or ¾" pipe connections. Diameter 4¼"; height 7"; weight 8 lbs. This trap is a natural for refinery and natural gasoline plant service.

For higher pressures and larger capacities Armstrong builds a complete line of heavy duty forged steel traps. Ask your nearby Armstrong representative to quote on the traps you need now.

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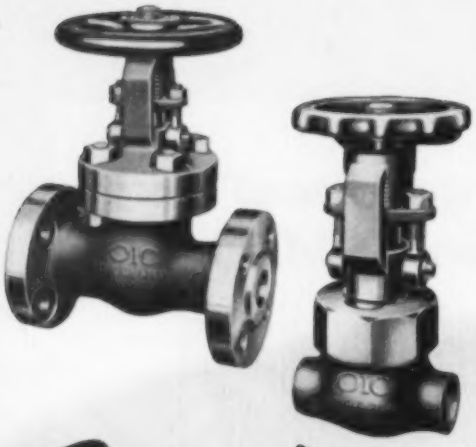
ARMSTRONG STEAM TRAPS



THE NEW O. I. C. LINE of forged-steel valves is built for 600 lb at 900 F in screw-end types, and for 600 lb at 750 F in flanged-end types. Sizes: with union bonnets, 1/4 in. to 3/4 in.; with bolted bonnets, up to 2 in.

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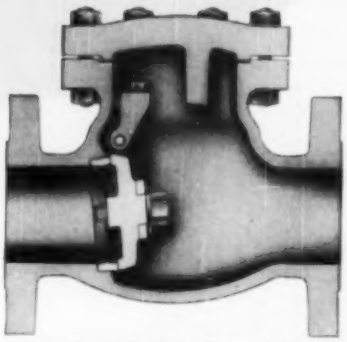

SWING CHECKS—Body designed for unobstructed flow; no tapped openings through the body wall; all internal parts removable through cap opening.

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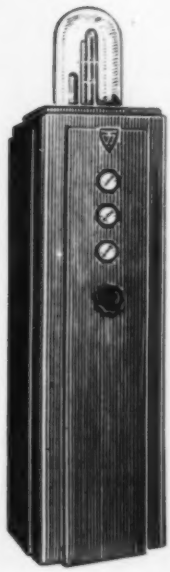

CD-32

Regardless of whether yours is an open or closed cooling system or whether you use shell and tube, trombone, or open box condensers, Wallace & Tiernan engineering plus time-tested W&T Chlorinators can put all the money-saving advantages of slime control by chlorination to work on your condensers or heat exchange equipment.

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New lightweight Flow Electrode Assembly for sampling line measurements.

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One of the new assemblies is an immersion-type unit, to operate in tanks, reactors, etc.: it can even be totally submerged if necessary. It also operates in many places which formerly required a flow-type unit: in such cases it eliminates both the installation and the maintenance of sampling line, pump and accessories. It is made of light, corrosion-resistant plastic.

The other new electrode assembly features convenience and stability where a flow-type unit must be used. Made of plastic, it is light, small, easy to install and thoroughly dependable. Where plastic might not suit, we of course continue to supply assemblies of cast iron and/or Pyrex brand glass.

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For application engineering simply fill in one of our "Controllability Analysis" forms. Our engineers can then tell how closely pH can be held with either present or proposed plant layout. Let's get together on that pH problem! You will not be obligated: simply write to Leeds & Northrup Co., 4923 Stenton Avenue, Philadelphia 44, Pennsylvania.

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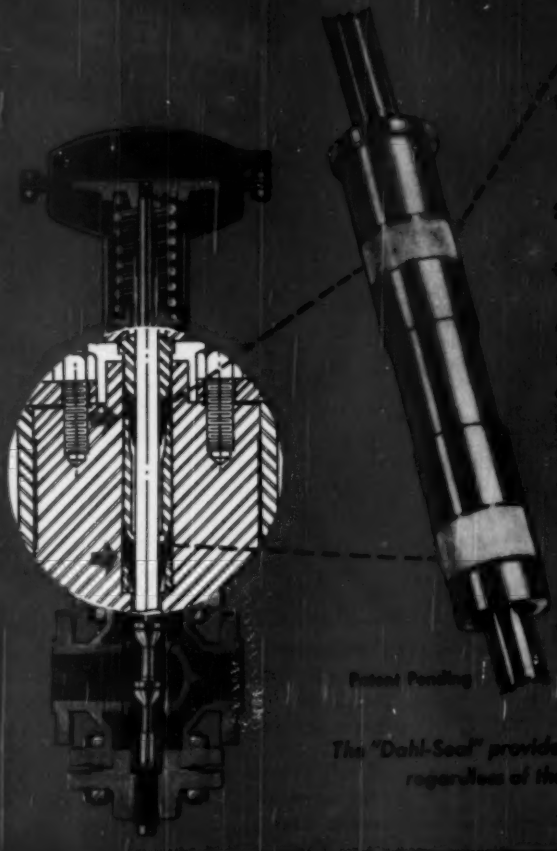
The "DAHL-SEAL"

Eliminates Packing Box and its problems.

No more leakage, friction, periodic take-up, adjustment, lubrication or replacements.



1. The valve stem can be positioned to an accuracy of 0.001" up to the working pressure for which the Valve Body is rated.
2. Eliminates conventional packing box leakage.
3. No periodic take-up or adjustment is necessary.
4. Seals by force of system pressure.
5. Negligible stem friction at any pressure.
6. Completely resistant to chemical attack.
7. Can be used for any temperature for which the valve is designed.
8. Available for any Hammel-Dahl Valve, including those now in service.

Patent Pending

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Corrosion...Temperature...Pressure

Can't faze

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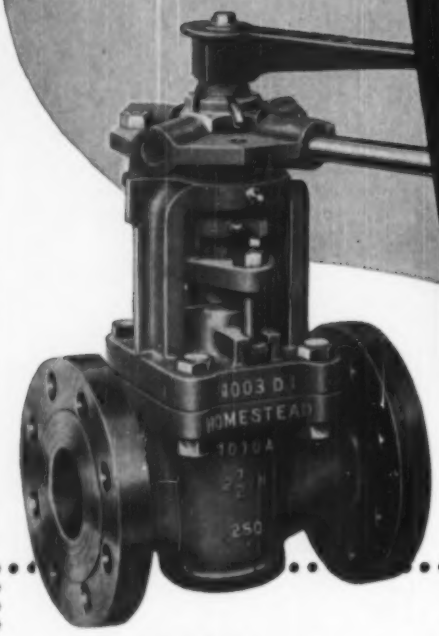
Lever-Seald
VALVES

They're Stick Proof



- Instant Stick-Proof operation.
- Quarter-turn fully opens or closes.
- Positive seal without lubrication.
- Seating surfaces always protected in both open and closed positions. Corrosion practically eliminated.
- Unobstructed straight-line fluid flow.
- All operating parts protected from damaging effects of service conditions and weather.

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HOMESTEAD LEVER-SEALD VALVES are made in metals and alloys to meet service requirements; sizes 1½" to 12"; for pressures from vacuum to 1500 pounds.

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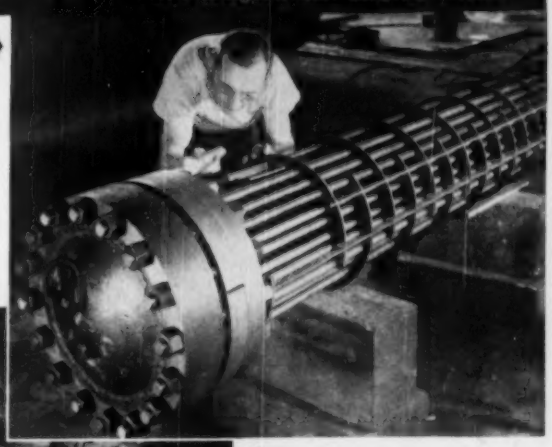
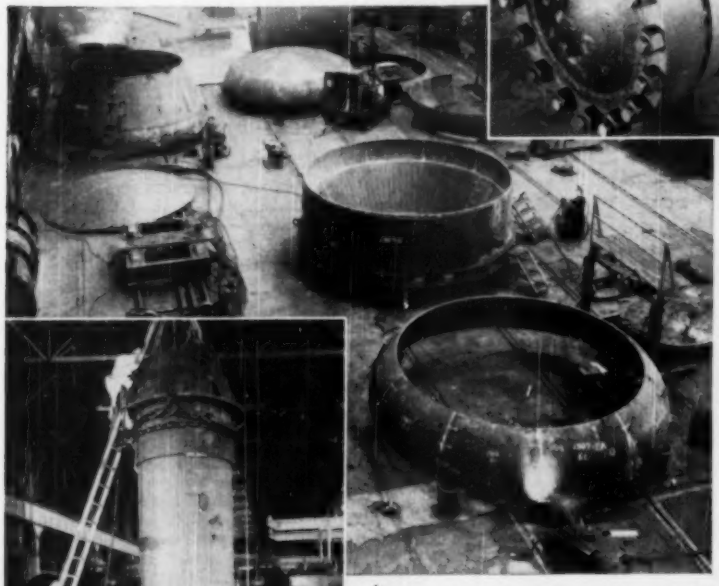
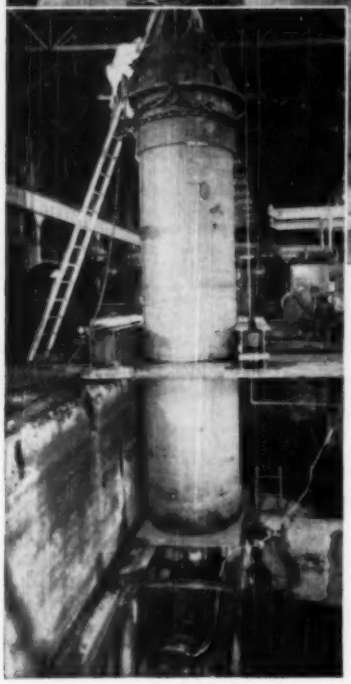
HEAT EXCHANGERS FOR HIGHER PRESSURES. A. O. Smith solid-backing ring construction makes the split-ring floating head safe for higher pressures. Four exchangers, like the one shown here at the right, were built for one company and tested at 1875 lb. for a working pressure of 1250 lb.







SHIPPING LIMITATIONS, PLANT LOCATIONS, OR BUILDING CLEARANCES ARE NO BARRIERS. A. O. Smith can provide field-assembled vessels built and erected to shop-quality specifications. Shown at the left are part of the segmental cones and heads for six coke drums, to be field assembled. Each vessel will weigh approximately 220,000 lb. when completed.

MULTI-LAYER VESSEL CONSTRUCTION FOR HIGHER PRESSURES. This 24 ft. long by 4 ft. diameter Multi-Layer lined A. O. Smith Autoclave was given a running-in test in excess of the working pressure of 2,000 psi.

A. O. Smith Corporation, Dept. PR-450
Milwaukee 1, Wisconsin

Send the latest A. O. Smith Vessel Bulletins:

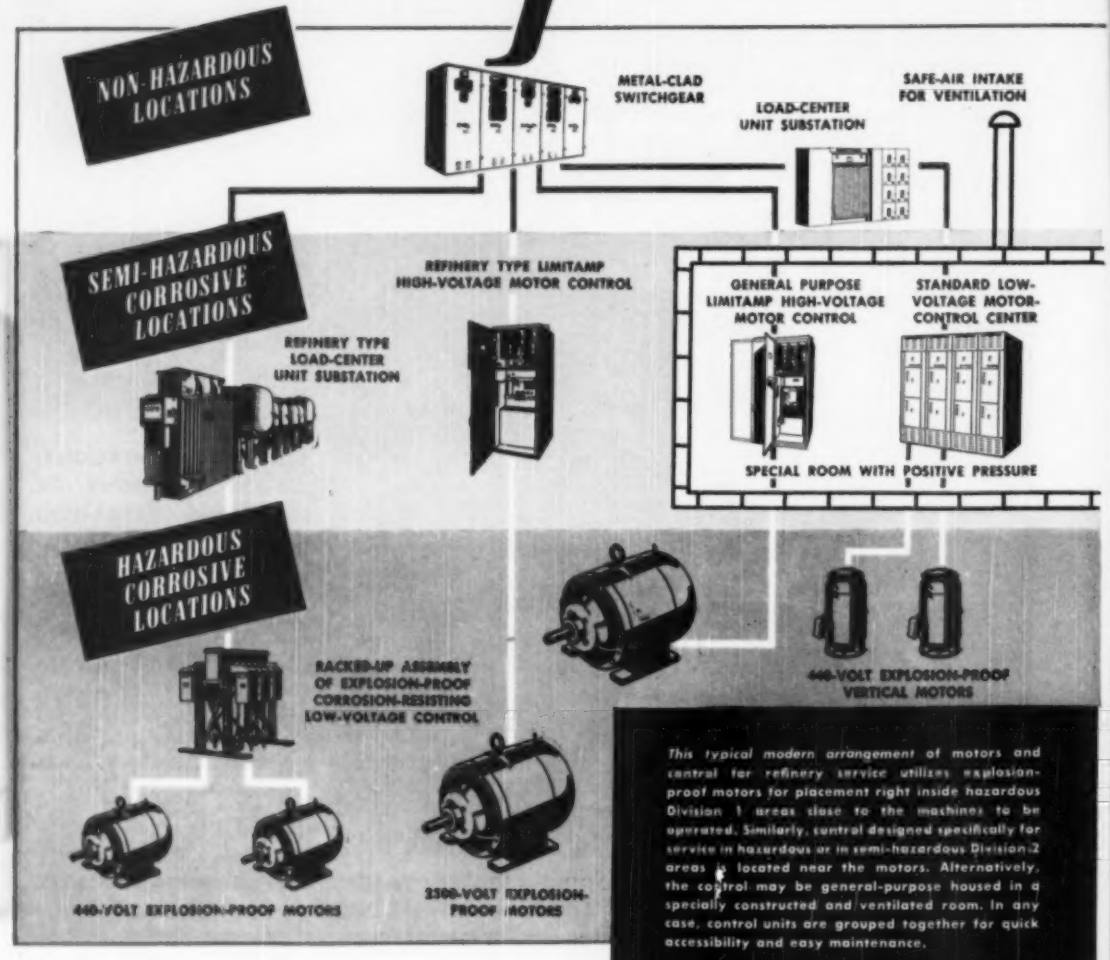
- ☐ V-46: Alloy, Alloy-lined, Clad, and Glass-lined Vessels
- ☐ V-44: Field Assembly of Pressure Vessels
- ☐ V-62: Multi-Layer Manufacture and Assembly

To: _____

Firm _____

Street _____ City _____ State _____

What's the trend in refinery electrification? } wider use of explosion-proof


NON-HAZARDOUS LOCATIONS
METAL-CLAD SWITCHGEAR
LOAD-CENTER UNIT SUBSTATION
SAFE-AIR INTAKE FOR VENTILATION
SEMI-HAZARDOUS CORROSIVE LOCATIONS
REFINERY TYPE LIMITAMP HIGH-VOLTAGE MOTOR CONTROL
REFINERY TYPE LOAD-CENTER UNIT SUBSTATION
GENERAL PURPOSE LIMITAMP HIGH-VOLTAGE MOTOR CONTROL
STANDARD LOW-VOLTAGE MOTOR-CONTROL CENTER
SPECIAL ROOM WITH POSITIVE PRESSURE
HAZARDOUS CORROSIVE LOCATIONS
RACKED-UP ASSEMBLY OF EXPLOSION-PROOF CORROSION-RESISTING LOW-VOLTAGE CONTROL
440-VOLT EXPLOSION-PROOF VERTICAL MOTORS
440-VOLT EXPLOSION-PROOF MOTORS
2300-VOLT EXPLOSION-PROOF MOTORS

This typical modern arrangement of motors and control for refinery service utilizes explosion-proof motors for placement right inside hazardous Division 1 areas close to the machines to be operated. Similarly, control designed specifically for service in hazardous or in semi-hazardous Division 2 areas is located near the motors. Alternatively, the control may be general-purpose housed in a specially constructed and ventilated room. In any case, control units are grouped together for quick accessibility and easy maintenance.

Here's what you need in motors and control for hazardous areas! }

WHEN YOU COME TO GENERAL ELECTRIC you get far more than the finest in electrical equipment. A General Electric application engineer, familiar with refinery practice, is at your disposal. If desired, he stands ready to take over the job of co-ordinating all the needed components, engineering your power distribution and utilization equipment into one modern, efficient system.

corrosion-resisting **motors and grouped controls**

—to simplify plant layouts, cut special construction costs!

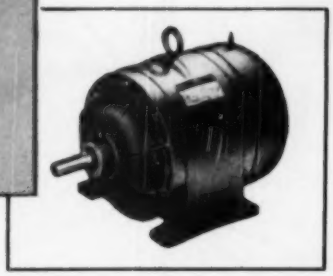
There are more ways than one, of course, to meet hazardous refinery conditions. But because it best combines simplicity, security, and savings, today's trend is toward greater use of explosion-proof, corrosion-resisting motors and group installation of control centers.

Its advantages? Motors and control can be located solely with reference to convenience, accessibility for maintenance, economy of space, and driving machinery. And because it's standard equipment, initial cost is lower.

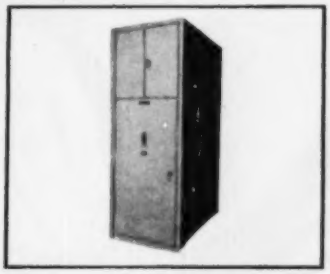
By minimizing explosion hazards, you promote personnel safety and continuity of production. Moreover, you can take full advantage of the cost-saving benefits of the load-center system of power distribution. Full information on motors and control for hazardous areas is contained in Bulletin GEA-4131. We'll gladly send you a copy. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

Have you seen the "More Power to America" full-color sound slidefilm "Modern Industrial Power Distribution"? Ask your G-E representative to arrange a showing for your organization.

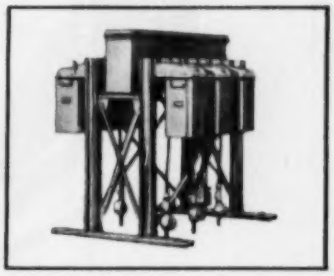
To meet refinery conditions and code requirements for hazardous areas, General Electric builds the most extensive line of explosion-proof motors on the market, in the widest variety of types, sizes, and ratings, and for the greatest number of hazardous conditions. In high- and low-voltage control, too, you have an unusually broad range to select from, made especially for use in hazardous and corrosive atmospheres. Let an experienced G-E engineer help you select the right combination for *your* special needs. Take the first step now—just call him at your nearest G-E office.



G-E Tri-Clad explosion-proof motors for Class I Group D hazardous locations have strong cast-iron frames and end shields. Non-sparking Textolite cooling fans standard on smaller sizes for greatest corrosion resistance.



G-E Limitamp high-voltage motor controls for semi-hazardous Class I Group D Division 2 areas—factory-assembled, space-saving units—give adequate short-circuit protection with high-IC current-limiting fuses.



G-E low-voltage control for hazardous Class I Group D Division 1 areas—in these convenient, racked-up standard assemblies of combination starters and breakers—save installation time, simplify maintenance.

GENERAL ELECTRIC

GEA-4

OLD DUTCH REPORTS

"Platformed gasoline has truly proved a boon to our sales department." That's the report from Old Dutch Refining Company, Muskegon, Michigan, where the first of the Platforming units has already proved its importance sales-wise.

"Where over-all gasoline inventories in this country are approaching an all time high, Old Dutch Refining Company has had no problem in this respect;

where

PLATFORMATE

pays off!

Blend *your* gasoline with Platformate, the product of the UOP Platforming process, and watch it pay off . . . in terms of increased gallonage.

Platformate is a blending component that boosts product quality even when your gasoline is made from the poorest stocks. Road octane of Platformate itself, when produced from the lowest octane naphthas (with 3 cc of lead) is rated nearly 100.

Platformate is inherently stable and negligible in sulfur content. There is more energy per gallon. The odor is pleasant. Production is economical.

Where increased gallonage depends on improved quality, depend on Platformate.

UNIVERSAL OIL PRODUCTS COMPANY

UOP General Offices: 310 S. MICHIGAN AVENUE, CHICAGO 4, ILL., U.S.A.
LABORATORIES: RIVERSIDE, ILLINOIS

Universal Service Protects Your Refinery

thanks to Platformed gasoline and the superior performance and quality it offers.

"Checking the sales figures of our branded outlets for a thirty-five day period this year against the same period in 1949, indicates a substantial increase in gallonage. New markets have been opened for a gasoline superior in anti-knock quality to the ordinarily accepted premium grade. New customers have been converted to regular customers . . . particularly the owners of new cars."

DA-1®

for reliable performance at peak efficiency...

DAVISON FLUID SYNTHETIC CRACKING CATALYST . . . *available in 3 grades—*

F-1, Fine Grind
C-1, Intermediate Grind
C-2, Coarse Grind

Davison offers you--

FACILITIES — Plants located in Baltimore and Cincinnati assure fast service and two reliable sources.

EXPERIENCE — Producers of catalysts since the installation of the first fluid catalyst cracking plant.

SERVICE — New and expanded facilities for catalyst testing and evaluation.

For special processes, Davison can place at your disposal an experienced staff and a modern, new plant devoted exclusively to the development and production of custom catalysts in granulated, powdered or pelleted form.

WRITE FOR INFORMATION AND SPECIFICATIONS

THE DAVISON CHEMICAL CORPORATION

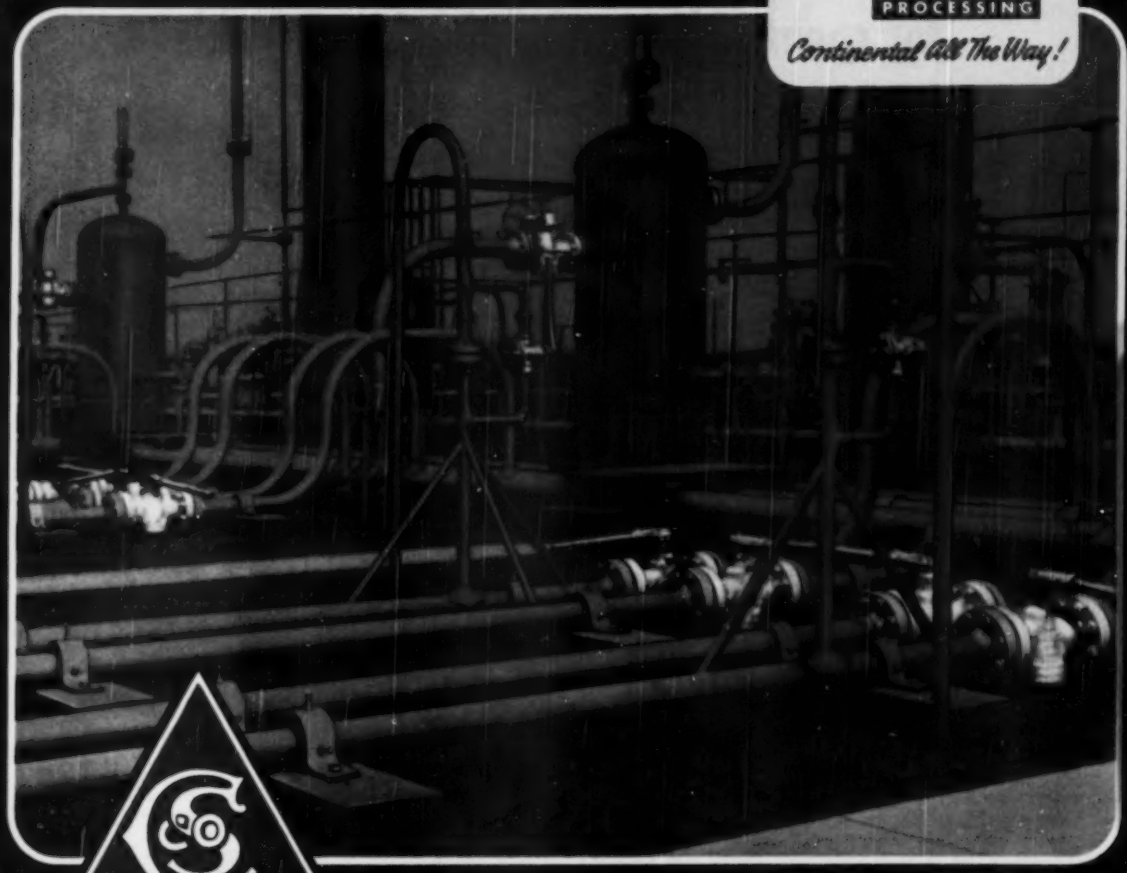
Progress through Chemistry

BALTIMORE-3, MD.

ALSO PRODUCERS OF: SILICA GEL, SILICOFLUORIDES, CASTING COMPOUNDS, ALUM, INORGANIC ACIDS, FERTILIZER MATERIALS, ASPHALT COMPOUNDS

Continental All the Way

SERVING THE NATURAL GASOLINE AND CYCLING INDUSTRIES



No phase of the oil industry has undergone such rapid growth as Natural Gasoline and Cycling. Constant improvements in methods and equipment have placed a great responsibility upon engineers, manufacturers . . . and distributors.

Equipment and supplies must be available where and when needed. To that end, Continental is applying its years of experience and know-how. The same dependable "Green Triangle" Service long known by men in drilling, production and transportation is now available to the Processing industries. It's "Continental All the Way" for *quality* and *service*.

- YOUNGSTOWN PIPE
- PLUG VALVES
- F. S. FLANGES
- UNIONS
- WELDING FITTINGS
- PAINT

CONTINENTAL

SERVING THE OIL AND GAS INDUSTRIES

THE CONTINENTAL SUPPLY COMPANY, *General Offices:* DALLAS, TEXAS

THE CONTINENTAL SUPPLY COMPANY, LIMITED
214 Lancaster Building Calgary, Alberta

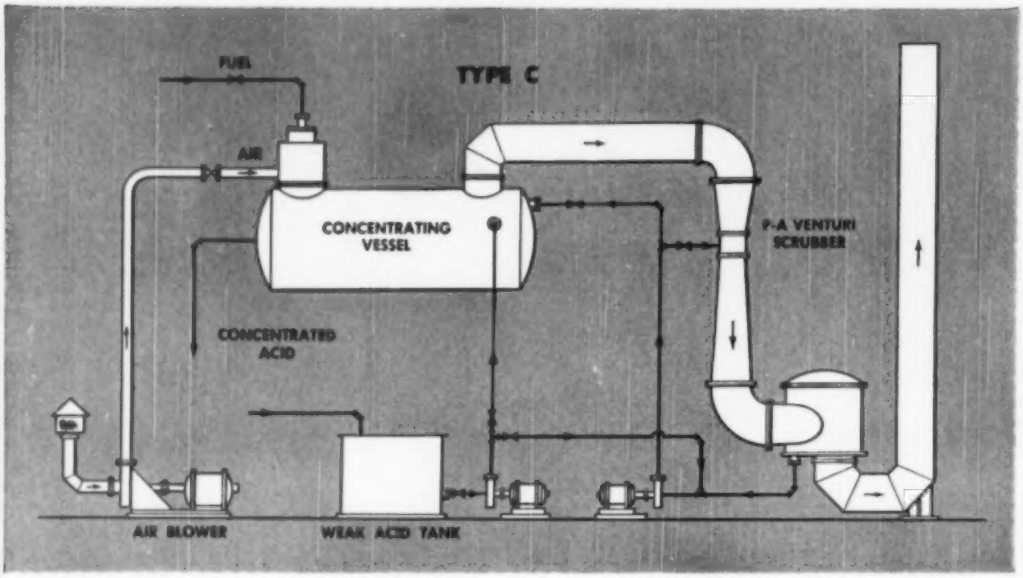
Export Division: THE CONTINENTAL SUPPLY CO., INC.
30 Rockefeller Plaza New York, N.Y.

Representatives: ARGENTINA • BOLIVIA • BRAZIL • CHILE • COLOMBIA • ENGLAND • ECUADOR • PERU • VENEZUELA • URUGUAY • VENEZUELA

Chemico Announces

NEW HIGH TEMPERATURE CONCENTRATOR

for spent sulfuric and phosphoric acids



THE NEW TYPE C High Temperature Acid Concentrator is a major improvement on the well known Chemico Drum Type Concentrator. This new unit is specially designed for concentrating spent sulfuric acid from petroleum refining, alcohol synthesis and nitrating operations as well as phosphoric acid from triple superphosphate operations.

The Type C unit employs the same principle as the Drum Type: Hot combustion gas is released under the surface of the acid where it gives up most of its heat and emerges at a temperature slightly above that of the acid itself. The combustion of the fuel takes place in the dip pipe, which withstands a high temperature on the *inside* and the corrosive action of acid on the *outside*.

But the new Type C Concentrator uses combustion gas at 2500F instead of 1100F. This high-temperature operation provides greatly improved heat efficiency. It also produces a much smaller volume of gas to be scrubbed at the concentrator exit. Here Chemico utilizes the recently developed and highly efficient P-A (Pease-Anthony) Venturi Scrubber which eliminates up to 99% of acid mist.

SEND FOR CHEMICO BULLETIN S-112, which fully describes this new Type C unit as well as the Type S Concentrator for acids containing soluble salts.

ADVANTAGES OF THIS NEW CHEMICO UNIT

1. Use of high temperature combustion gas assures high heat efficiency.
2. Retains the best features of the Chemico Drum Type Concentrator.
3. Low initial investment.
4. Low operating cost.
5. Low maintenance cost.
6. Acid concentration through all ranges of strength up to 96%.
7. High acid recovery.
8. Built-in fume eliminator (P-A Venturi Scrubber).
9. Specially adapted for use on acids containing salts as, for example, waste pickling solutions.
10. No heat transfer surfaces to cake up.
11. Fully guaranteed by Chemical Construction Corporation who have more than 35 years of experience in this field and a background of more than 200 successful concentrating unit installations.

CHEMICAL CONSTRUCTION CORPORATION

A UNIT OF AMERICAN CYANAMID COMPANY

EMPIRE STATE BLDG., 350 FIFTH AVENUE, NEW YORK 1, N. Y.

EUROPEAN TECHNICAL REPRESENTATIVE
CYANAMID PRODUCTS LTD., BRETTENHAM HOUSE, LANCASTER PLACE, LONDON W. C. 2, ENGLAND

CABLES: CHEMICONST, NEW YORK

CC-195

Chemico Plants are Profitable Investments

ASHCROFT DURAGAUGE

"Progressive Research has meant continuous leadership for over 100 Years"

A few Ashcroft "firsts" that have anticipated the needs of industry:

1921—Ashcroft introduces the micrometer adjustable pointer.

1924—The rotary movement is announced by Ashcroft.

1929—The phenol condensate plastic case is an Ashcroft "first" this year.

1932—Bourdon Tubes of stainless steels are announced by Ashcroft research engineers.

1936—Stainless steel movements, for greater service life, join the long list of Ashcroft Gauge features.

1939—"K" Monel Bourdon Tubes, for services that would corrode stainless steel, introduced by Ashcroft.

1939—Laminated phenol dials make this year a big one in Ashcroft development.

1947—Ashcroft research engineers announce the new, revolutionary Nylon Movement*.

*Pat. applied for.

1850—A century of service to American Industry—1950

MAXWELL MANNING MOORE INC. TRADE MARK

ASHCROFT *Gauges*

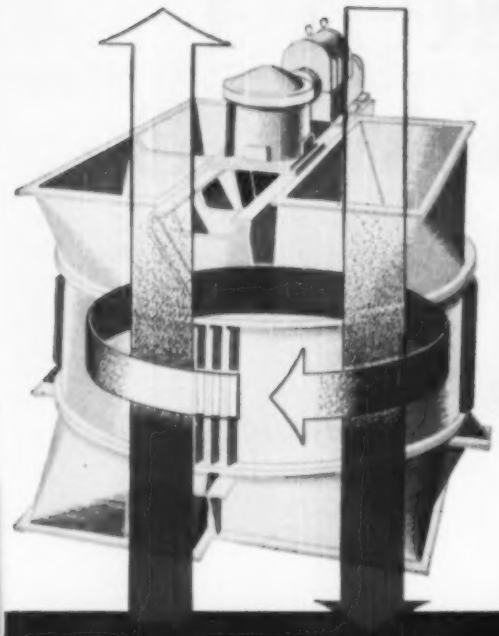
A Product of

MANNING, MAXWELL & MOORE, INC.

STRATFORD, CONNECTICUT

1850 ASHCROFT U.S.A.

Makers of 'Ashcroft' Gauges, 'Hancock' Valves, 'Consolidated' Safety and Relief Valves, 'American' Industrial and 'Microsen' Electrical Instruments. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists and other lifting specialties.



this preheater is cutting fuel costs in hundreds of plants

the *Ljungstrom* AIR PREHEATER

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.

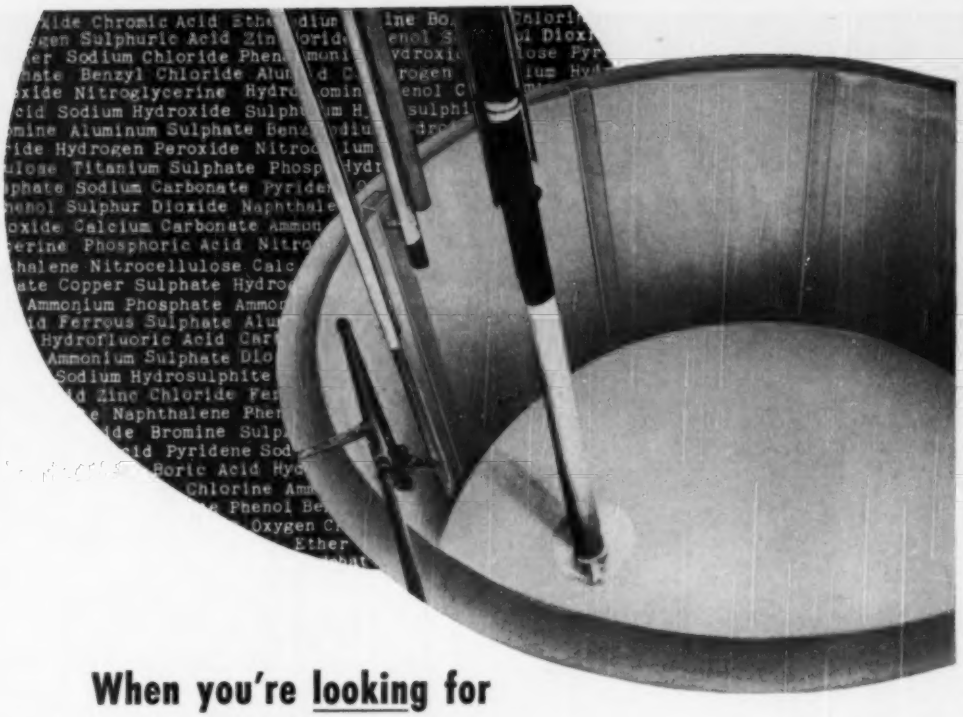
The Ljungstrom air preheater has proved its value in industrial and utility plants throughout the country. That is why every year a constantly increasing percentage of the installed boiler capacity is equipped with Ljungstrom air preheaters.

Your fuel costs will be lower too, when your boiler is equipped with the Ljungstrom air preheater. The regenerative design of the Ljungstrom permits reliable operation at low exit gas temperatures. This assures the greatest possible heat recovery . . . reduces the amount of fuel required.

If you are planning a new installation, or expanding your present one, our engineers will welcome the opportunity to show you how the Ljungstrom can raise the overall efficiency of *your* plant.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.



When you're looking for

LEAD LININGS

to take the "bite" out of corrosive chemicals

If your processing operations involve the handling of corrosive chemicals... you'll want tank linings of lead. Why? Because lead is the *able* metal. It not only is *able* to resist corrosion, but is also adapt*able*, work*able*, dur*able*, and salvage*able* after many, many years of service.

National Lead sheet with this unique combination of abilities is available in these grades: *chemical*, "standard" for most uses; *tellurium*, for increased corrosion resistance and strength at high temperatures; *antimonial*, for strength, stiffness and hardness; *tellurium-antimonial*, for extra hardness where erosion or cutting is a problem; *Nalco Metal*, a new lead alloy developed to give longer, better service in handling chromic acid solutions.

Basic metal for all these grades is "St. Joe chemical lead,"—produced from Southeast Missouri ores. This lead is universally recognized as best for handling chemicals.

When you need lead linings, buy National Lead sheet. For, as the leader in lead, National gives you the benefit of metal resources, mechanical equipment, and production know-how second to none. Plants in all principal cities.

...look to the Leader in Lead

...for everything from lead pipe...valves...sheet ...and lead-lined or lead-covered equipment...to a complete acid recovery plant

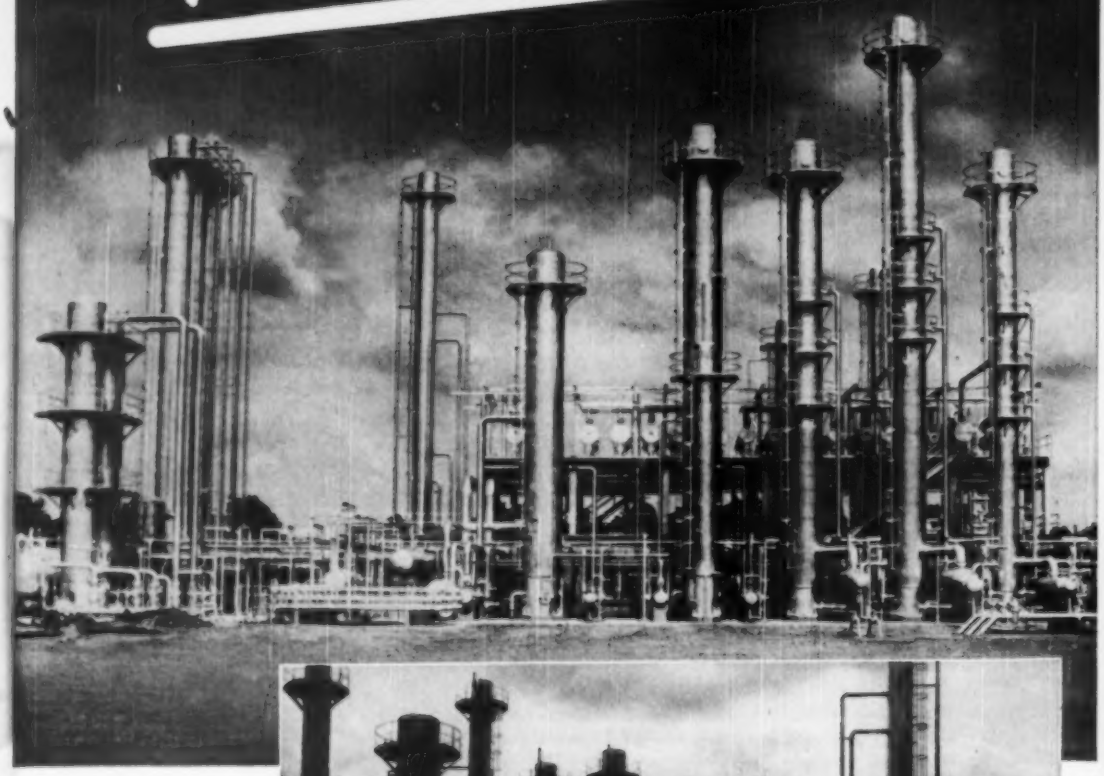
NATIONAL
LEAD COMPANY

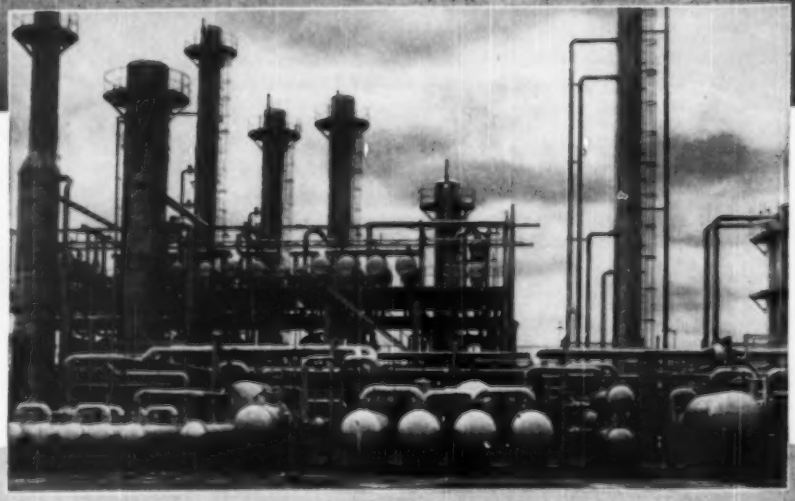
New York 6; Atlanta; Baltimore 3; Buffalo 3; Chicago 8; Cincinnati 3; Cleveland 13; Philadelphia 25; Pittsburgh 12; St. Louis 1; Boston 6 (National Lead Company of Mass.); Los Angeles 23 (Morris P. Kirk & Son, Inc.); Toronto, Canada (Canada Metal Co. Ltd.).

Dutch Boy PRODUCTS

Trademarks Reg. U. S. Pat. Off.

More than 100





GRISCOM-RUSSELL PIONEERS IN HEAT TRANSFER APPARATUS

GR. 234.

G-R Heat Exchangers

in this installation

...*how many can you find?*

The engineers of this natural gas plant indicated their conviction of the superiority of G-R Heat Transfer Apparatus in the most definite manner . . . by ordering 110 G-R units for their heat transfer services.

THE ROSTER OF G-R EQUIPMENT IN THE PLANT IS AS FOLLOWS:

- 40 Shell-and-Tube units for coolers, condensers and oil-to-oil exchangers
- 2 Steam-heated Reboilers
- 61 Twin G-Fin Sections for gas coolers and product coolers
- 5 Oil Chillers using propane as the chilling medium
- 1 Fin-Fan Steam Condenser
- 1 Type R Evaporator

Here, as in many other plants throughout the oil and gas industry, G-R Heat Transfer Apparatus has been selected because of the long G-R leadership in developing designs to meet the advancing needs of the industry, and the proven excellence of performance of G-R equipment.

Whatever may be *your* heat transfer requirements, be sure to consult G-R . . . pioneers in heat transfer apparatus . . . for authoritative recommendations.

THE GRISCOM-RUSSELL CO.

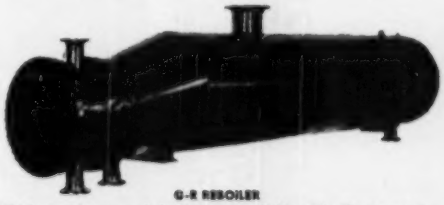
285 MADISON AVE., NEW YORK 17, N. Y.

G-R TWIN G-FIN SECTION

The "universal" standard interchangeable heat transfer unit with longitudinally-finned elements. More than 40,000 installed sections.

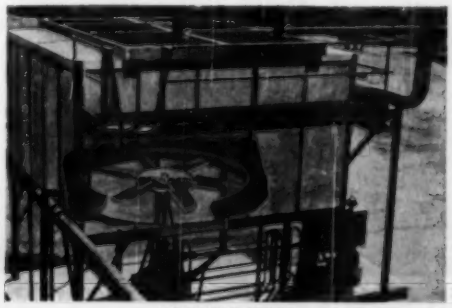
G-R TUBULAR EXCHANGER

A shell-and-tube unit with many distinctive features for efficient performance with minimum attendance and maintenance expense.



G-R REBOILER

Widely used in process industries, and available with either bare tubes or K-Fin helically finned elements.



FIN-FAN EXCHANGER

The "package-type" air-cooled exchanger developed jointly by The Griscom-Russell Co. and Floor Corp. Ltd., and widely adaptable wherever the cooling water supply is insufficient or impure.

GRISCOM-RUSSELL

Built by GRAVER

Regenerator-reactor unit and stripper . . . main catalyst storage hopper . . . auxiliary catalyst storage hopper for new cat cracker of Wood River Oil & Refining Co., Inc., Hartford, Ill.

Congratulations

WOOD RIVER on the new fluid catalytic cracking unit now on stream, making high octane cat-cracked gasoline. Graver is proud of its part in the completion of this 7500-barrel-per-day unit, designed and licensed by Universal Oil Products Company.

Graver fabricated and erected the reactor and regenerator column and two large catalyst storage hoppers. The reactor is 13′ 6″ inside diameter and the regenerator is 19′ 8″ inside diameter at the bottom. The entire unit stands about 150 feet high.

This work for WOOD RIVER again identifies Graver with new refining plants and prompts investigation by refiners who are planning new catalytic cracking units.

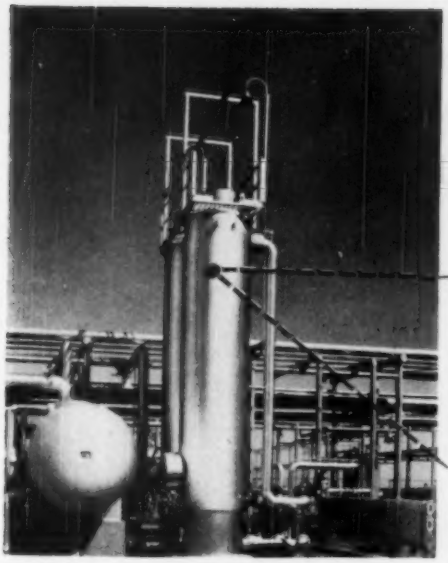
GRAVER

FABRICATED PLATE DIVISION

GRAVER TANK & MFG. CO., INC.

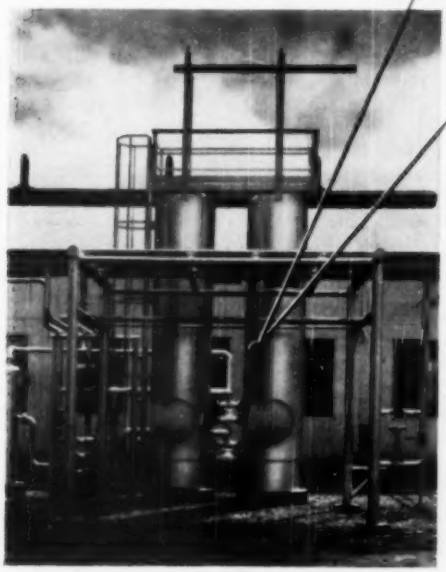
EAST CHICAGO, INDIANA

NEW YORK • PHILADELPHIA • CHICAGO • CATASAUQUA, PA. • HOUSTON • SAND SPRINGS, OKLA.



LIQUID DEHYDRATION UNIT

Each tower is charged with 1590 lbs. of ALCOA *Activated* Alumina. Approximately 240,000 gallons of liquid hydrocarbons are dried daily to a dew point of minus 40° F. Liquid enters the towers at 90° F. and 390 psig. Reactivation on an 8-hour cycle with liquid hydrocarbons heated to 450° F.



AIR DEHYDRATION UNIT

Approximately 100,000 cubic feet of air entering the towers at 80° F. and 50 psig, are dried to *minus* 40° F. dew point daily. Each tower contains 5900 lbs. of ALCOA *Activated* Alumina. Air, heated to 450° F., regenerates the alumina on a 16-hour cycle.

both AIR and LIQUID dried to **minus 40° F.** with ALCOA Activated* Alumina

These drying units were designed for the Maysville, Oklahoma, unit of the Garvin County Plants, operated by Warren Petroleum Corporation for itself and four other owners. ALCOA *Activated* Alumina was selected as the desiccant to do the job because it dries *both* liquid and air quickly, efficiently and economically.

ALCOA *Activated* Alumina is a commercially pure, highly inert adsorbent that has high resistance to crushing, shock and abrasion. It does not soften, swell or disintegrate even when immersed in water. It can be reactivated an almost unlimited number of times with no appreciable effect on efficiency. This, coupled with its relatively low initial cost, makes ALCOA *Activated* Alumina a most economical drying agent.

Let us send you complete information on this reliable, versatile desiccant. Write to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 617D Gulf Building, Pittsburgh 19, Pa.

*Reg. T. M., Aluminum Company of America

Alcoa Chemicals

ALCOA

ALUMINAS and FLUORIDES

ACTIVATED ALUMINAS • CALCINED ALUMINAS • HYDRATED ALUMINAS • TABULAR ALUMINAS • LOW SODA ALUMINAS • ALUMINUM FLUORIDE • SODIUM FLUORIDE • SODIUM ACID FLUORIDE • FLUOBORIC ACID • CRYOLITE • GALLIUM

REDUCE PIPE LINE MAINTENANCE COSTS with CHAPMAN

TILTING DISC

Check Valves

Because of their unique design, Chapman Tilting Disc Check Valves *close without slamming*. There is no water-hammer . . . no vibration of pipe lines or adjacent structure. Nor any danger of opening up pipe joints or rupturing pipe lines. All mighty important reasons why maintenance costs are bound to go down when you standardize on this valve with the cushioned closing.

Yet that's only part of the story. Chapman Check Valves also reduce head losses 65% to 85% over conventional type check valves. And, when installed on pump discharge lines, they not only make possible increased pipe-line capacity but also effect substantial power savings.

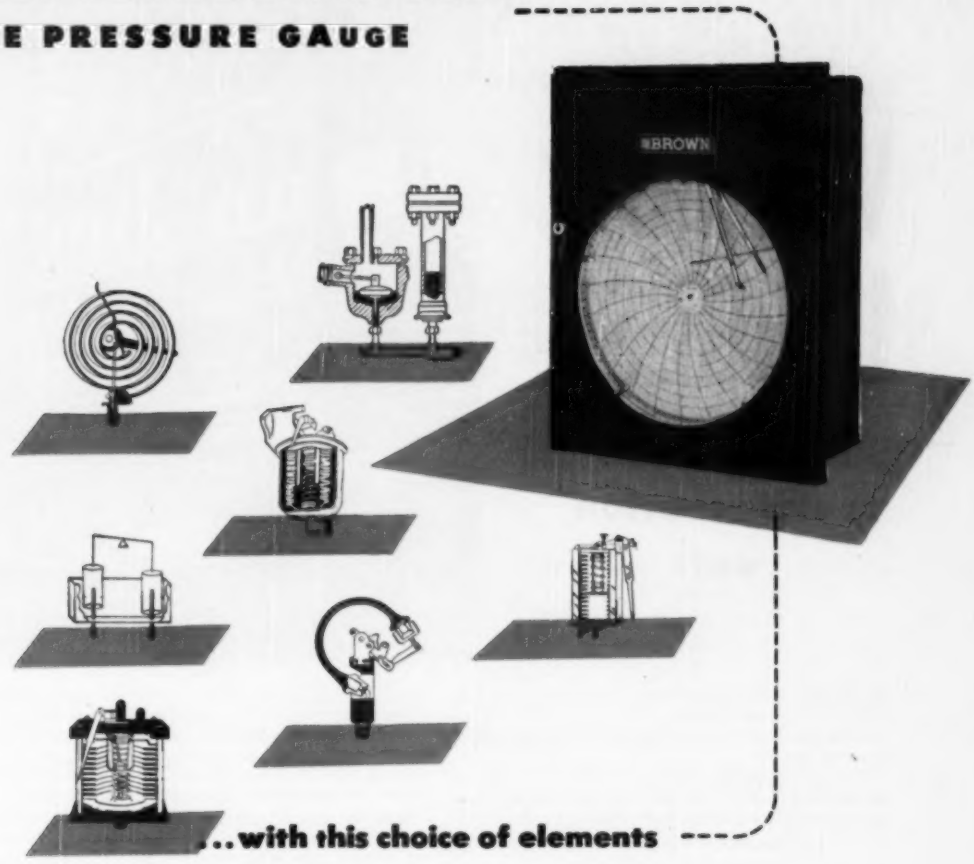
Why not send for bulletin with engineering data *today*?

Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

THE CHAPMAN VALVE MANUFACTURING COMPANY

INDIAN ORCHARD, MASSACHUSETTS

ONLY BROWN GIVES YOU THE PRESSURE GAUGE



THE BROWN PRESSURE GAUGE has long been the standard of comparison for almost all of industry . . . because of its continuous, trouble-free performance and its unmatched sensitivity.

Its performance is the result of engineered design, rugged construction and simplicity of operation. The wide range of measuring elements is responsible for its sensitivity. There's a specific element for every pressure application . . . from microns to tons . . . from corrosive to non-corrosive.

Your local Honeywell engineer is as near as your phone. Call him in for a discussion of your pressure problems . . . or write for a copy of Catalog 7000!

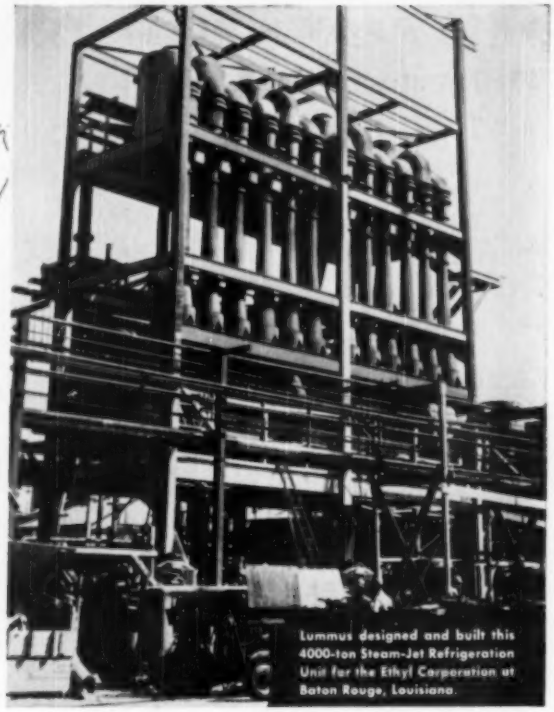
WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL
COMMERCIAL · RESIDENTIAL · INDUSTRIAL

MINNEAPOLIS-HONEYWELL REGULATOR CO.
BROWN INSTRUMENTS DIVISION
4498 Wayne Avenue, Philadelphia 44, Pa.
Offices in 77 principal cities of the United States, Canada and throughout the world

Honeywell — *Advanced Instrumentation* FOR THE PETROLEUM INDUSTRY — BROWN INSTRUMENTS

WORLD'S LARGEST

steam-jet refrigeration unit



Lummus designed and built this 4000-ton Steam-Jet Refrigeration Unit for the Ethyl Corporation at Baton Rouge, Louisiana.

No similar unit as large as this 4000-ton giant had ever been operated before, but Lummus' record of achievement and heat-transfer engineering experience won the contract.

The unit provides a dependable, low-cost supply of chilled water. Like all Lummus steam-jet refrigeration units, it has these operating advantages:

- *no expensive refrigerant replacement*
- *no moving parts to replace*
- *low maintenance cost*
- *simple operation*
- *long service life*

Lummus steam-jet refrigeration units are used to chill water for air conditioning systems and for petroleum, chemical, and other industrial processes. These units operate with minimum quantities of steam and condensing water, utilizing either exhaust or live steam and do not require specially treated make-up water.

Whether your refrigerating requirement is in tens or thousands of tons, you can get a dependable, economical steam-jet unit engineered for the job by Lummus. Many standardized units are available to meet a wide range of requirements. If your problem is a special one, Lummus engineers have the knowledge and experience to help solve it.

THE LUMMUS COMPANY
Heat Exchanger Division
250 West 14th Street, New York 11, N. Y.

LUMMUS

Atlanta • Boston • Chicago • Cleveland
Detroit • Ft. Worth • Houston • Minneapolis • Pittsburgh
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Montreal • Paris • Rome • San Juan, P. R.

Write for illustrated bulletin

We shall be glad to send you a copy of a publication containing 16 pages of design data, illustrations, and diagrams of heat transfer equipment. Ask for Bulletin M-303.

LOOK TO LUMMUS for Steam Surface Condensers • Evaporators • Feed Water Heaters • Boiler Blowdown Heat Exchangers Steam Jet Air Ejectors • Steam Jet Refrigeration • Barometric Condensers • Heat Exchangers • Process Condensers • Reboilers Steam Generators (Indirect Fired) • Fuel Oil Heaters • Lubricating Oil Coolers • Pipe Line Coolers • Jacket Water Coolers

Tame those touchy hydrocarbons

with a BJ Stuffingboxless Pump

Engineered for safe, simple, economical handling of butane, propane, ethane and other volatile hydrocarbons . . .

CAN'T ESCAPE

Leakage of pumped fluid to atmosphere is impossible. The motor and close-coupled pump are totally enclosed in a sealed pressure vessel. There's no fire hazard or danger to property or personnel caused by leakage.

ABLE TO CONTAIN HIGH PRESSURES

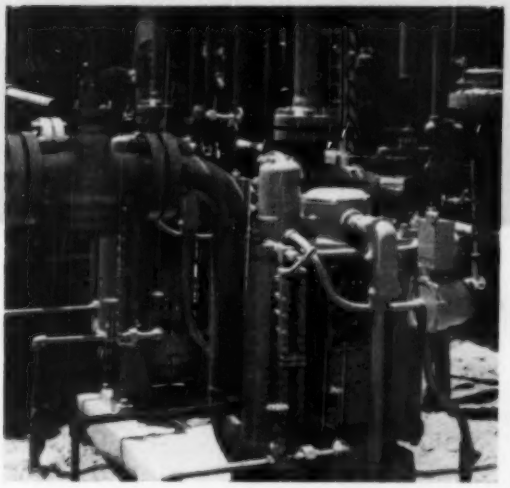
BJ's pressuring system maintains a predetermined pressure across the mechanical seal that separates the motor from the pump within the chamber. This pressure is constant, regardless of suction and discharge pressures.

NO "KEEPER" NEEDED

No special attendant is needed to guard against leakage and consequently no costly maintenance time is spent in repacking and adjusting.

OPERATING SAVINGS

While the first cost of the BJ Stuffingboxless Pump is somewhat higher, big and continuing savings are offered in operation. There's no product loss through leakage, no downtime due to flood-out.



THE *RIGHT* PUMP FOR YOUR JOB

The BJ Stuffingboxless Pump is available in a wide range of models and pressuring system combinations to meet individual requirements. Byron Jackson Co. engineers are ready to help you secure the BJ Stuffingboxless Pump best suited to your job. Write, wire or phone today.

Byron Jackson Co.

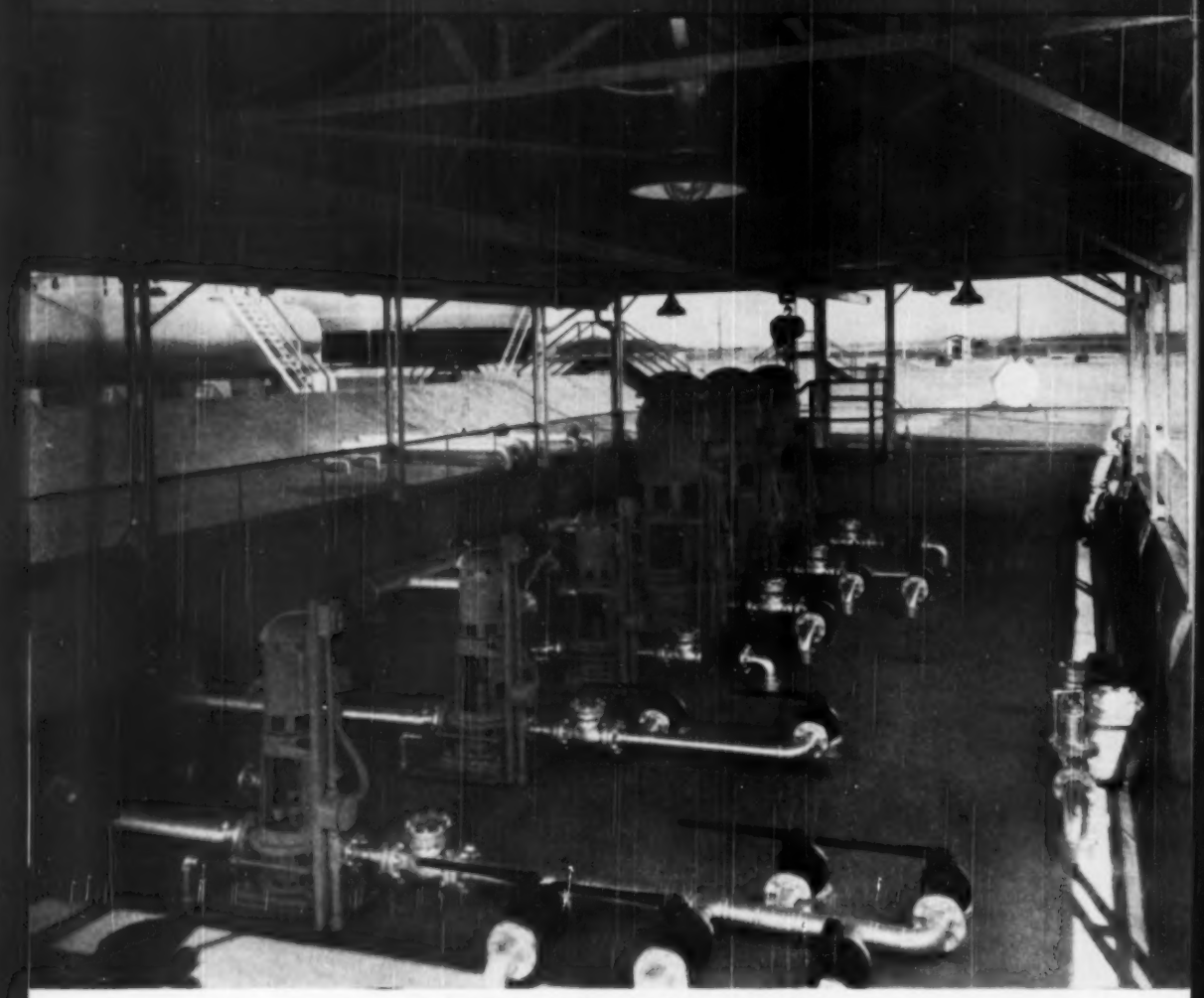
Since 1872

P. O. Box 2017 Terminal Annex, Los Angeles 54, Calif.

OFFICES IN PRINCIPAL CITIES

⇦ **THESE BJ STUFFINGBOXLESS PUMPS** handle ethane in a de-ethanizing operation. Pumping temperature is 80° F; suction pressure 490 psig; discharge pressure 520 psig; capacity 100 gpm; speed 3550 rpm; total head 165'; and specific gravity 0.42.

PRODUCTS HANDLING.



Nordstroms in a products pipe line pumping station.

Nordstrom Valves

NOW AUTOMATICALLY LUBRICATED WITH Hypermatic

TRADE MARK

PATENTS APPLIED FOR

Hypermatic lubricant makes tremendous improvement in Nordstrom valves. Being *energizable* it self-seals, self-feeds, keeping the valves in a 100% lubricated condition, for prevention of leakage and insuring most positive operation. Maintenance costs are cut to the minimum.

. . infinitely safer with NORDSTROMS

● In handling petroleum products you first consider *safety*. That calls for ever-tight valves, free from freezing, free to turn easily, positively sealed around the ports regardless of line pressure. Note how perfectly the Nordstrom design fits these specifications. The tapered plug is pressure lubricated, held tight on its unexposed seat by resilient means; the lubricated seat permits easy rotary turning of the plug, as contrasted to metal-to-metal unlubricated seats in common types; "Sealdport" lubrication surrounds each port to prevent leakage; the plug can be hydraulically jacked when required.

For handling gasoline, distillates, butane, propane and other petroleum products, Nordstroms have no equal. They keep upkeep down.

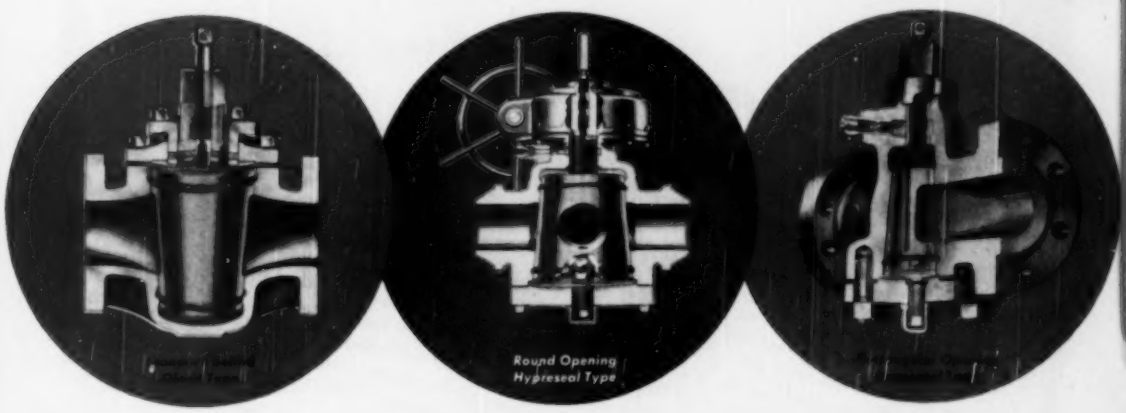
Put Nordstroms to ANY test

Install them, for test, side by side with any other type, check their operation, compare their performance . . . make a record of maintenance costs. You will find them to be tops in performance—and by far the most economical valves you have ever used. Successful operation of over 5,000,000 Nordstroms is proof of performance.

Nordstrom Valve Division—ROCKWELL MANUFACTURING COMPANY

400 North Lexington Avenue • Pittsburgh 8, Pennsylvania

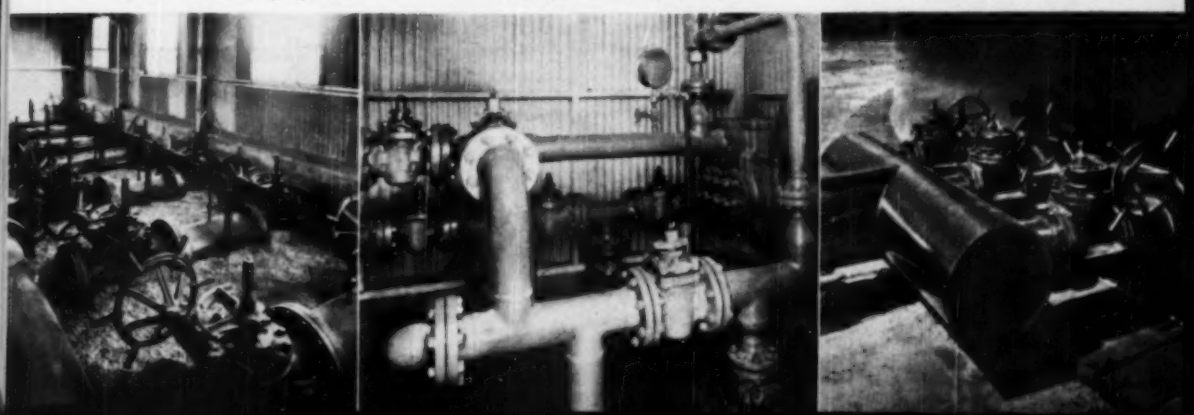
Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa
. . . and leading Supply Houses • Export: Rockwell Manufacturing Co., International Division, 7701 Empire State Building, New York 1, N. Y.



Nordstrom valves in a products pump station.

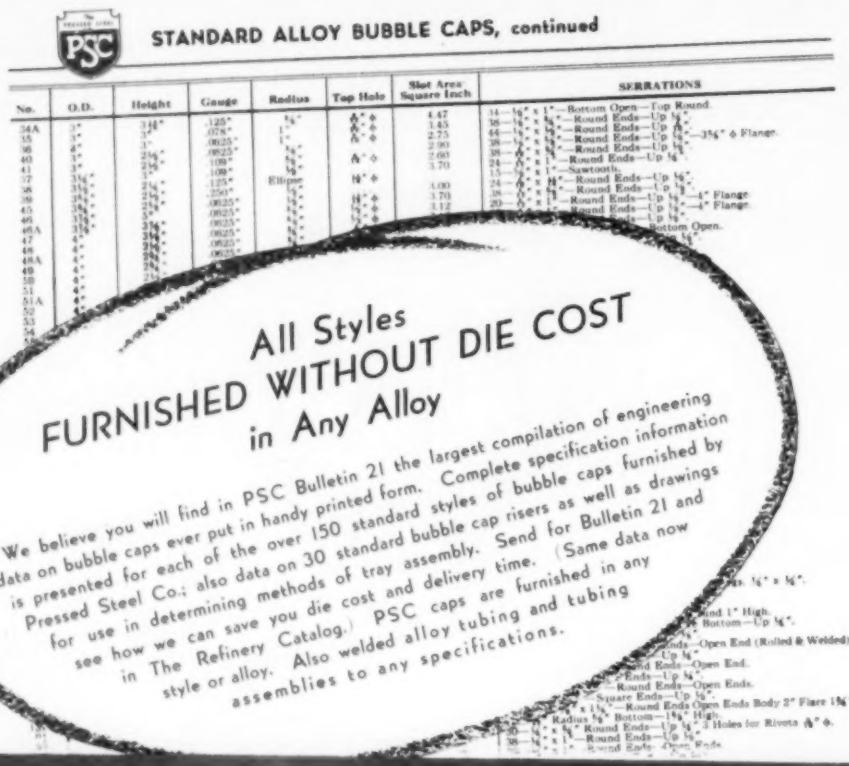
Nordstroms on products line in pump house.

Nordstroms on connections to gasoline storage tank.



MEMO TO REFINERY ENGINEERS:

PSC Bulletin 21 LISTS COMPLETE DATA on over 150 STANDARD STYLES of Bubble Caps



STANDARD ALLOY BUBBLE CAPS, continued

No.	O.D.	Height	Gauge	Radius	Top Hole	Slot Area Square Inch	SERRATIONS
34A	3"	1¼"	.125"	⅝"	⅞" ◇	4.47	14—⅛" x 1"—Bottom Open—Top Round.
35	3"	1"	.078"	1"	⅞" ◇	3.45	36—⅛" x ⅜"—Round Ends—Up ⅛".
36	4"	1"	.0125"	1"	⅞" ◇	2.75	44—⅛" x ⅜"—Round Ends—Up ⅛"—3¼" ◇ Flange.
40	3"	2⅛"	.109"	⅝"	⅞" ◇	2.90	36—⅛" x ⅜"—Round Ends—Up ⅛"—3¼" ◇ Flange.
41	3"	2⅛"	.109"	⅝"	⅞" ◇	2.60	36—⅛" x ⅜"—Round Ends—Up ⅛".
42	3"	2⅛"	.109"	⅝"	⅞" ◇	3.70	24—⅛" x 1"—Round Ends—Up ⅛".
47	3¼"	2⅛"	.125"	Elliptical	⅞" ◇		15—⅛" x 1"—Sawtooth.
48	3¼"	2⅛"	.125"	⅝"	⅞" ◇	3.00	24—⅛" x ⅜"—Round Ends—Up ⅛".
48	3¼"	2⅛"	.250"	⅝"	⅞" ◇	3.70	28—⅛" x 1"—Round Ends—Up ⅛"—4" Flange.
48	3¼"	2⅛"	.0125"	⅝"	⅞" ◇	3.12	20—⅛" x 1"—Round Ends—Up ⅛"—4" Flange.
48	3¼"	2⅛"	.0125"	⅝"	⅞" ◇		—Round Ends—Up ⅛".
48A	3¼"	2⅛"	.0125"	⅝"	⅞" ◇		—Up ⅛"—Bottom Open.
47	4"	2⅛"	.0125"	⅝"	⅞" ◇		⅛".
48	4"	2⅛"	.0125"	⅝"	⅞" ◇		
48A	4"	2⅛"	.0125"	⅝"	⅞" ◇		
49	4"	2⅛"	.0125"	⅝"	⅞" ◇		
50	4"	2⅛"	.0125"	⅝"	⅞" ◇		
51	4"	2⅛"	.0125"	⅝"	⅞" ◇		
51A	4"	2⅛"	.0125"	⅝"	⅞" ◇		
52	4"	2⅛"	.0125"	⅝"	⅞" ◇		
53	4"	2⅛"	.0125"	⅝"	⅞" ◇		
54	4"	2⅛"	.0125"	⅝"	⅞" ◇		
55	4"	2⅛"	.0125"	⅝"	⅞" ◇		
56	4"	2⅛"	.0125"	⅝"	⅞" ◇		
57	4"	2⅛"	.0125"	⅝"	⅞" ◇		
58	4"	2⅛"	.0125"	⅝"	⅞" ◇		
59	4"	2⅛"	.0125"	⅝"	⅞" ◇		
60	4"	2⅛"	.0125"	⅝"	⅞" ◇		

All Styles
FURNISHED WITHOUT DIE COST
in Any Alloy

We believe you will find in PSC Bulletin 21 the largest compilation of engineering data on bubble caps ever put in handy printed form. Complete specification information is presented for each of the over 150 standard styles of bubble caps furnished by Pressed Steel Co.; also data on 30 standard bubble cap risers as well as drawings for use in determining methods of tray assembly. Send for Bulletin 21 and see how we can save you die cost and delivery time. (Same data now in The Refinery Catalog.) PSC caps are furnished in any style or alloy. Also welded alloy tubing and tubing assemblies to any specifications.

THE PRESSED STEEL COMPANY
of WILKES-BARRE, PENNSYLVANIA

Industrial Equipment of Heat and Corrosion Resistant WEIGHT-SAVING *Sheet Alloys*

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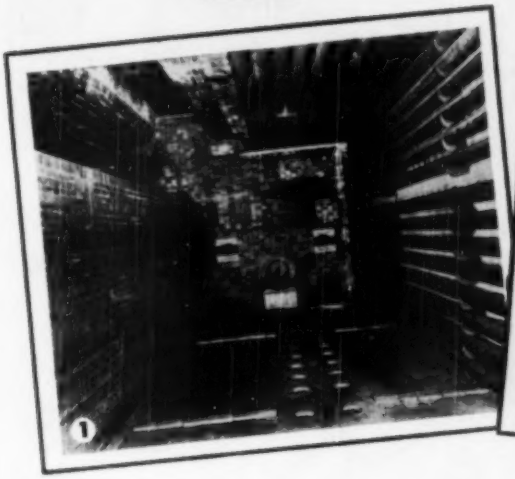
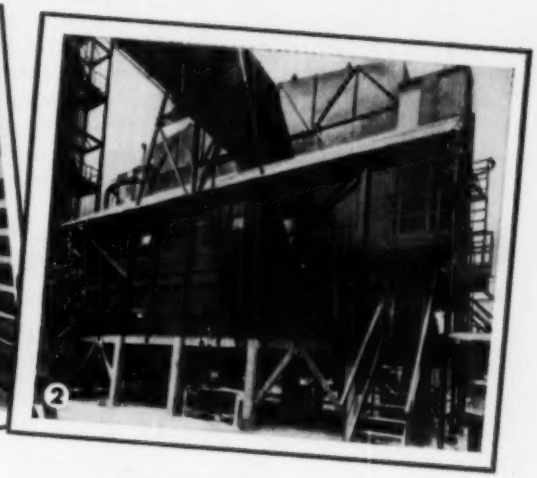
4 Sure Ways to Save Money in PROCESS FURNACES





In process furnace operation, every dollar counts. That's why leading manufacturers of chemical and petroleum process furnaces save their customers money *four ways* by using B&W Insulating Firebrick. These durable, lightweight brick . . .

1 CUT INSTALLATION COSTS — B&W Insulating Firebrick are easy to install. They can be cut, drilled or shaped on the job with ordinary woodworking tools. Their lightness makes them easy to handle.

2 ELIMINATE EXPENSIVE ALLOYS — Because of their high insulating values, B&W Insulating Firebrick can be supported with ordinary carbon steel hangers. Expensive, heat-resisting alloys are not necessary.

3 REDUCE DOWN-TIME — These brick have low heat storage, cool off quickly. This makes possible quick access to the furnace for inspection. They heat up quickly to get back on the line, too.

4 LAST FOR YEARS — In thousands of installations, B&W Insulating Firebrick have proved their staying power. Process furnace operators know these brick offer long, maintenance-free service.

You, too, can profit by this four-way economy of B&W Insulating Firebrick. Ask your B&W representative for all the facts on these cost-cutting refractories. He'll be glad to discuss your refractory problems with you.

① Interior of The M. W. Kellogg Co. Feed Preheater Furnace lined with B&W K-26 IFB.
② Exterior view of Feed Preheater Furnace.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 85 LIBERTY ST., NEW YORK 6, N.Y.
WORKS: AUGUSTA, GA.

R-968

B&W REFRACTORIES PRODUCTS — B&W 80 Firebrick • B&W Junior Firebrick • B&W 80 Glass Tank Blocks • B&W Insulating Firebrick B&W Refractory Castables, Plastics and Mortars • OTHER B&W PRODUCTS—Stationary & Marine Boilers and Component Equipment... Chemical Recovery Units . . . Seamless & Welded Tubes . . . Pulverizers . . . Fuel Burning Equipment . . . Pressure Vessels . . . Alloy Castings

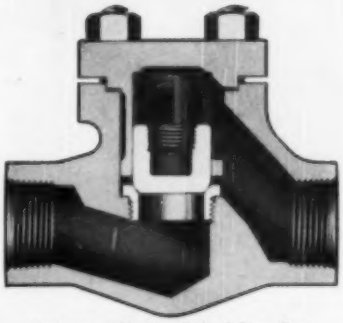
Piping for every refinery installation ...from one complete line...CRANE

SEVERE SERVICE SUITS THESE CHECK VALVES

Rugged, yet unusually compact, Crane 600-Pound Forged Steel Lift Checks are made specifically to withstand severe service on high pressure, high temperature steam and oil lines. Famous Crane Quality in design, materials and workmanship assures maximum strength and longer valve life.

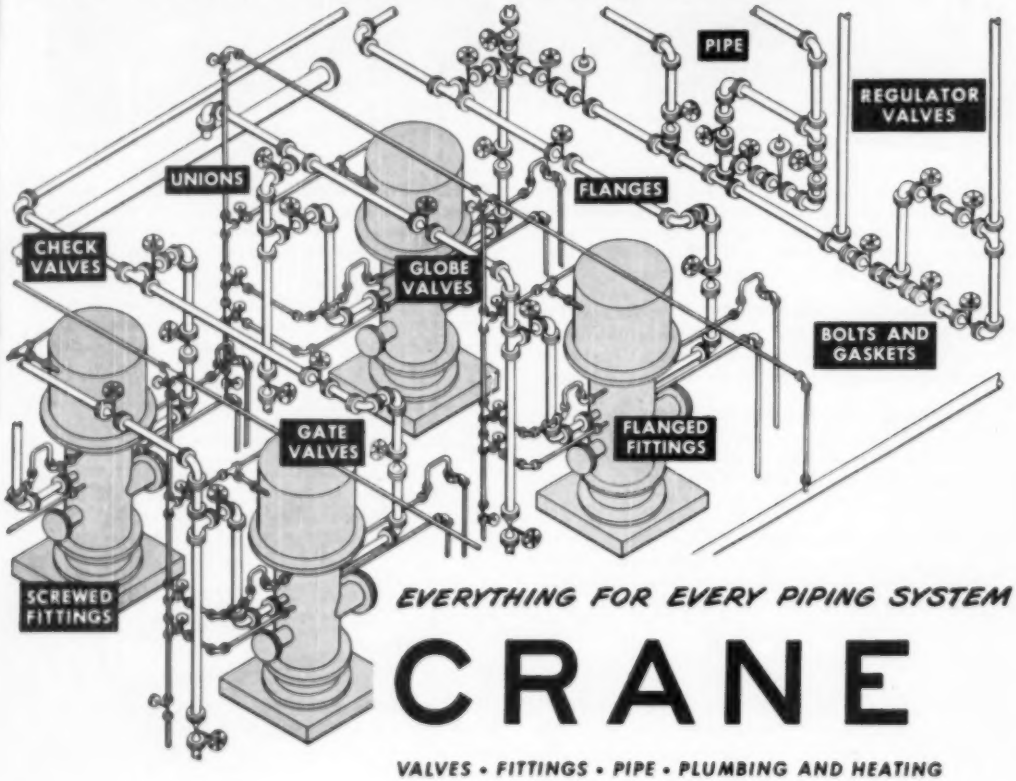
Crane forged carbon steel valve body—reinforced with heavy metal sections—provides a high margin of safety. Both the seat and disc are made of wear-resisting Exelloy. The high-lift disc operates in a specially designed cap that assures proper guiding, square seating, and eliminates destructive chattering. For further information, see your new No. 49 Crane Catalog, p. 248-9.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas



Horizontal Check—Bolted Cap. For oil or oil vapor services up to 1000° F.; for steam up to 850° F. and for water, air or gas. Sizes: ½ to 2 in. Screwed, flanged or welding ends.

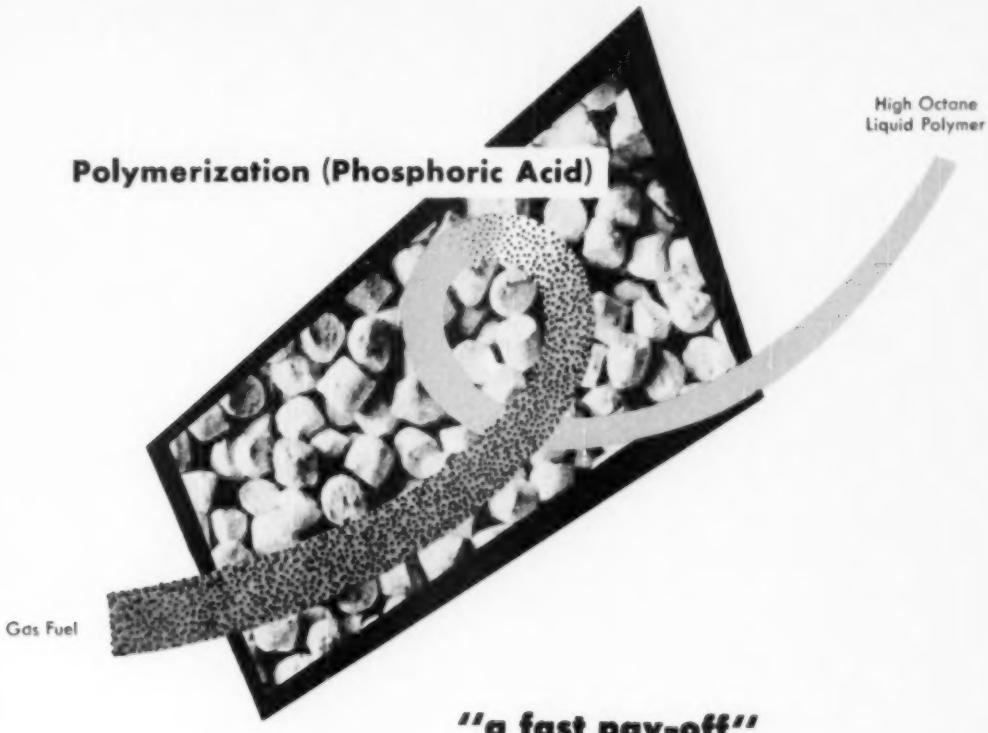
● ONE ORDER TO CRANE COVERS ALL PIPING EQUIPMENT NEEDED FOR THESE GLAND OIL AND COOLING WATER LINES



EVERYTHING FOR EVERY PIPING SYSTEM

CRANE

VALVES • FITTINGS • PIPE • PLUMBING AND HEATING



"a fast pay-off"

Catalytic Polymerization (Phosphoric Acid) is probably the most economically attractive process in Petroleum Refining. It is a simple low-cost operation, and if properly designed, will remain on stream for extended periods. A Foster Wheeler designed polymerization unit recently completed 3 years of continuous operation before it was shut down for general inspection.

Foster Wheeler will build within the next year 3 large polymerization units and the design and construction experience gained from these projects is available to other refiners,—anywhere in the world.

FOSTER WHEELER CORPORATION

165 BROADWAY, NEW YORK 6, NEW YORK

"Out of the sands of Iran"

. . . rises one of the world's largest Fluid Catalytic Cracking Units, designed and constructed by Foster Wheeler.

Four other "Fluid" units (one larger than the Abadan unit in the above illustration) are in various stages of Foster Wheeler design and construction.

design

engineering

fabrication

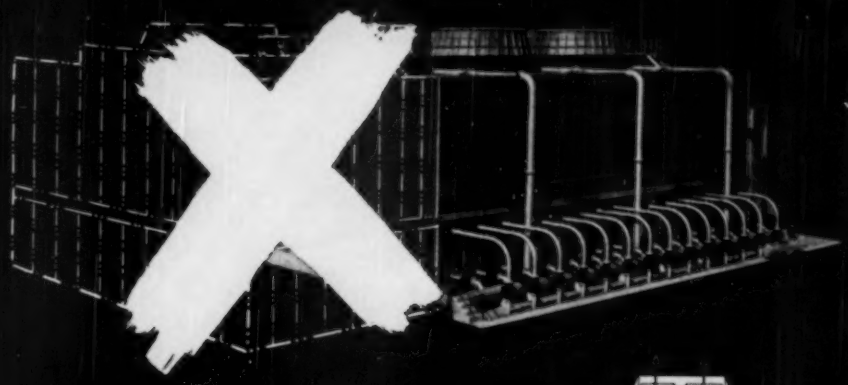
construction

FOSTER WHEELER CORPORATION

165 BROADWAY, NEW YORK 6, NEW YORK

The Complete Engineering and Construction Service Anywhere in the World

LOST! One Sale!



Several years ago, one of America's largest pipeline companies installed Marley Double-Flow cooling towers at each compressor station. Recently, an unprecedented demand for natural gas caused each station to be "beefed up" to carry the unexpected heavy load.

A Marley Application Engineer was called in to give his recommendations for enlarging the cooling towers to give the colder water needed to cool the heavily loaded gas coil circuit.

After a complete survey of the water cooling needs, he found that colder water was needed to cool the additional load in the gas coils, but that the compressor engine jacket water cooling circuits and the compressor itself could operate with slightly warmer water.

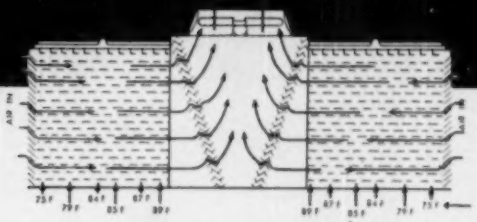
Instead of recommending an extension of each existing Double-Flow, he explained how the Marley Double-Flow cooled from "outside-in" as well as from top to bottom. This results in near-wet bulb temperature water falling in the collecting basin near the louvered side walls.

By installing longitudinal partitions in the cold water basin near the louvered walls, water 7 F to 9 F colder than that specified on the original cooling tower installation could be circulated over the gas coolers . . . and the customer's problem was solved without a capital expenditure.

Yes, MARLEY LOST A SALE—But the customer SAVED MONEY . . . PLENTY OF IT!

This is but one of the many case histories on file proving that Marley "know-how" and Marley Double-Flow cooling towers will do any job better and at less cost. In this case, ONLY A MARLEY DOUBLE-FLOW could have solved the problem. And, ONLY MARLEY DOUBLE-FLOW will give Cross-Flow Water Cooling—an Open Distribution System—Mortise Lock Filling—Low Draft Loss—Marley Mechanical Equipment and other exclusive Marley features. Truly, TOMORROW'S COOLING TOWER IS HERE TODAY . . . at MARLEY!

Get more for your money . . . Save time . . . Save trouble. Ask a Marley Application Engineer to work with you, from the "blue-print" stage on. He'll help you solve your problem without cost or obligation.



Typical water temperatures in a Double-Flow tower just before water enters the cold water basin. Temperature of water in cold water basin is 86 F.

The cross-flow of dry air entering the Double-Flow tower through the entire height of the louvered side wall cools water in this area to almost wet bulb temperature. Water in a cross-flow tower is cooled from outside-inside as well as from top to bottom.

MAIL THIS COUPON TODAY

The Marley Company, Inc., Kansas City 15, Kansas

- ☐ Please send FREE copy of "What's Your Cooling Tower I.Q.?" Illustrated folders available on Cooling Tower Operation, Maintenance, Water Treatment, Testing, Specifications.
- ☐ Send Double-Flow Bulletin DF-50.
- ☐ Have Marley Application Engineer call. PR-4

Name _____ Title _____

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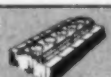
City _____ Zone _____ State _____

MARLEY


Double-Flow

Vairflo

DriCooler

Natural Draft

Counter-Flow

Aquatower

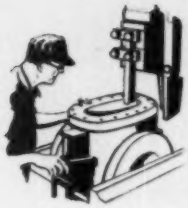
Spray Nozzles

A Condenser is dependable when it is made up of Wolverine Condenser Tubes

IT is dependable because the Wolverine tubes supplied are of the exact alloy that will meet your particular corrosion conditions and operating requirements. Our engineers see to that!—and specify only the alloy that will perform with the highest efficiency.

Put your trust in Wolverine Condenser tubes. We have a catalog showing sizes and alloys available. Would you like a copy?

WOLVERINE TUBE DIVISION
Calumet & Hecla Consolidated Copper Company
INCORPORATED
MANUFACTURERS OF SEAMLESS, NON-FERROUS TUBING
1431 CENTRAL AVE. • DETROIT 9, MICHIGAN



A DISTINCTIVE FE..TURE IN DISC GUIDING

Body guides are machined down to precision tolerances, assuring a perfect guide for the disc and creating a positive center line on which all subsequent machining operations are based.

BODY PRECISION MACHINED TO INSURE PERFECT FIT OF SEAT RINGS

This operation makes inserting the seat rings in a Lunkenheimer gate valve simply a matter of screwing them into position. Parts can be replaced without any machine work or special fitting.

Precision Made LUNKENHEIMER VALVES....

assure perfect-fitting, interchangeable parts... longer valve life... easier, lower-cost maintenance!

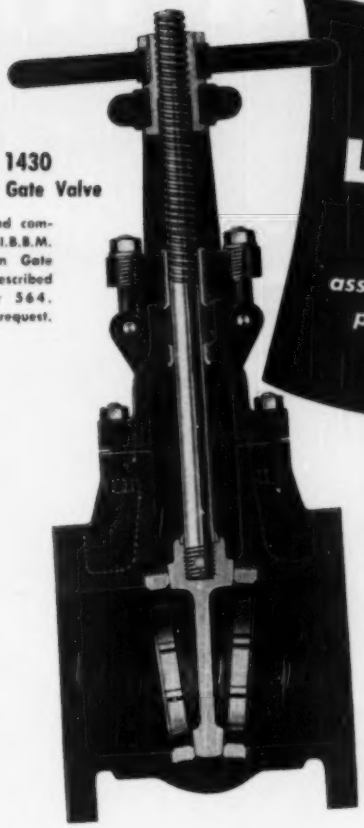


Fig. 1430
Iron Body Gate Valve

Fig. 1430 and complete line of I.B.B.M. and All Iron Gate Valves are described in Circular 564. Mailed upon request.

THE smooth working efficiency and low maintenance cost of Lunkenheimer Valves were not "made in a day." Behind this superior performance and economy lies long experience, top engineering and metallurgical facilities together with the most modern manufacturing equipment.

Lunkenheimer Valves have a streamlined simplicity of design . . . a minimum of working parts, each part of extra strength, correctly proportioned and perfectly balanced. This assures longer life with lower maintenance expense.

LET THE LUNKENHEIMER DISTRIBUTOR "TAKE OVER" YOUR INVENTORY PROBLEMS!

There are Lunkenheimer Distributors in every petroleum producing center. Their stocks help you reduce inventory overhead and obsolescence.

ESTABLISHED 1862

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EXPORT DEPT. CINCINNATI 14, OHIO, U.S.A.

Economic Analyses

Process Design

Knowledge of Corrosion Problems

Mechanical Design

Controls and Instrumentation

Scheduling

Estimating

Drafting

Procurement

Inspection

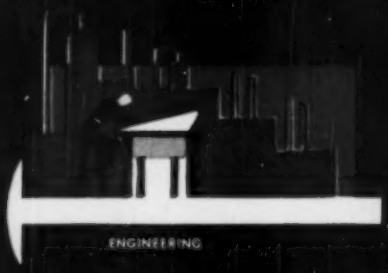
Expediting

Field Construction

Labor Relations

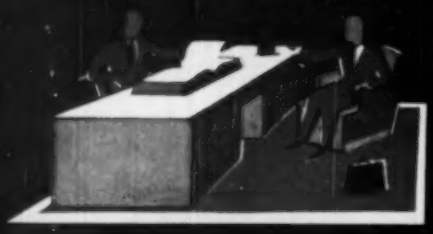
Initial Plant Operation

Intimate Knowledge of Latest Technical Developments



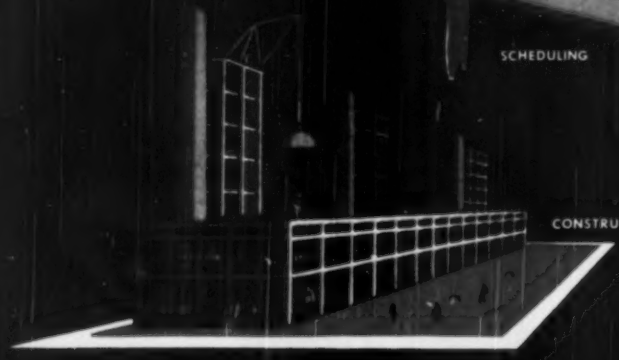
ENGINEERING

FROM THE



PURCHASING

SCHEDULING



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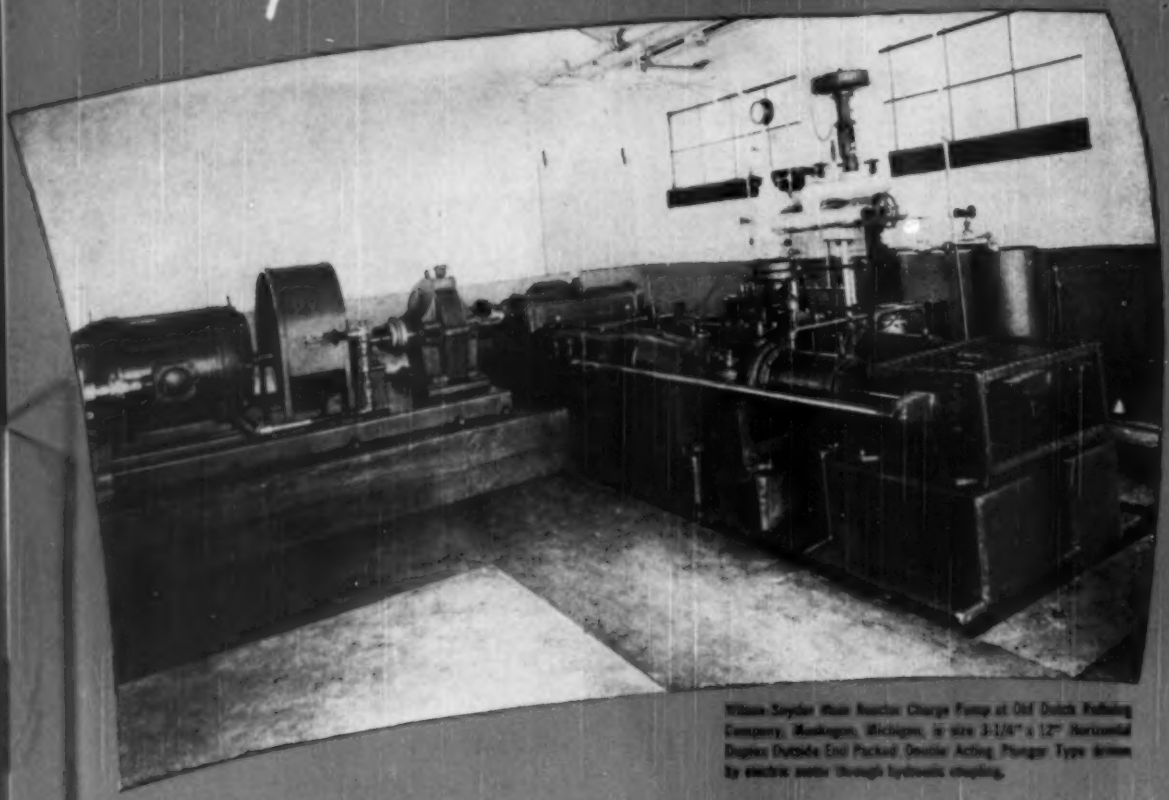

Wilson-Snyder Main Reactor Charge Pump at Old Dutch Refining Company, Muskegon, Michigan, is size 3-1/4" x 12" Horizontal Duplex Outside End Packed Double Acting Plunger Type driven by electric motor through hydraulic coupling.

Wilson-Snyder Pump selected for the "heart" of UOP Platforming Process

PLATFORMING . . . the petroleum refining process that utilizes a catalyst containing platinum . . . was discovered and developed by Universal Oil Products Company. The process is employed to improve the octane characteristics of straight run and natural gasolines, and has already proved its merit in commercial operation at the Muskegon, Michigan refinery of Old Dutch Refining Company.

Wilson-Snyder Refinery Pumps have long enjoyed an excellent reputation for performance and reliability. That is the reason UOP selected a Wilson-Snyder as the Main Reactor Charge Pump for this first platforming installation.

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A complete line of Wilson-Snyder reciprocating and centrifugal pumps are available for all types of refinery operations. Write for engineering information.

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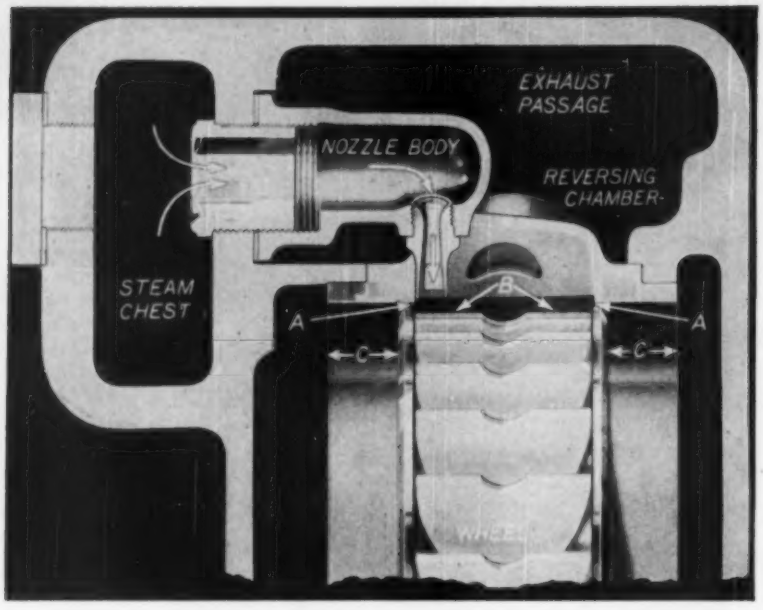

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Large blade and rim clearances and extra large side clearance — one inch — help make Terry One-piece Wheel Turbines highly dependable in operation.

The blades cannot foul because of the protection afforded by the rims, which are not damaged, should rubbing occur.

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Terry Bulletin S-116 will give you full information on the Terry Wheel Turbine. A request on your business letterhead will bring you a copy.

T-1171

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FOR FORTY YEARS THE GREATEST NAME IN INSULATED PIPING SYSTEMS

How much should a valve cost?

Only as much as is necessary for it to meet all the conditions under which it must operate.

When the service in which a valve is to be used requires special design and materials, it is poor economy to try to make an inexpensive valve do the job. "Down time", maintenance costs, if not actual valve failure, will far more than offset any initial saving.

On the other hand, in a majority of services, standard Powell Valves satisfy all requirements for long, trouble-free performance.

And, because Powell makes all kinds*, it is the soundest economy to standardize on Powell Valves for all your flow control requirements.

Fig. 1561—Class 150-pound Cast Steel Swing Check Valve with flanged ends and bolted cap.

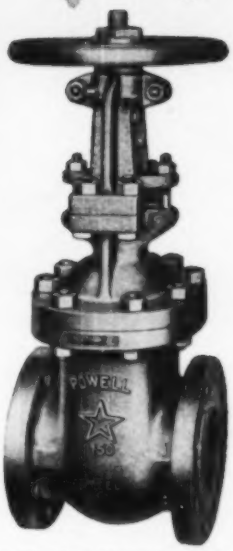

Fig. 1503—Class 150-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

Fig. 375—200-pound Bronze Gate Valve. Screwed ends, inside screw rising stem, union bonnet, renewable wear resisting "Powellium" nickel-bronze disc.

Fig. 1400—Iron Body Bronze Mounted "Master Pilot" Gate Valve with screwed ends, rising stem, bolted flanged bonnet and tapered solid wedge.

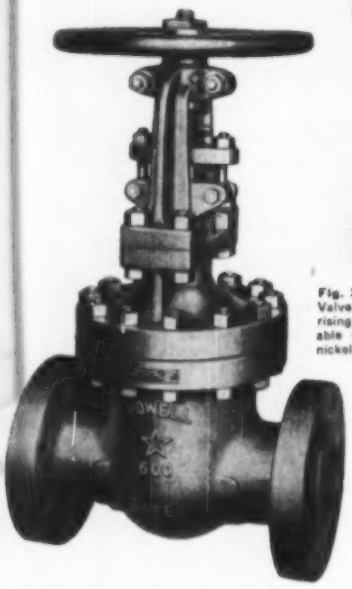

Fig. 6003—Class 600-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

*The Complete Powell Line includes Globe, Angle, "Y", Gate, Check, Non-return, Relief, and Flush Bottom Tank Valves in Bronze, Iron, Steel and a wide range of Corrosion-resistant metals and alloys.

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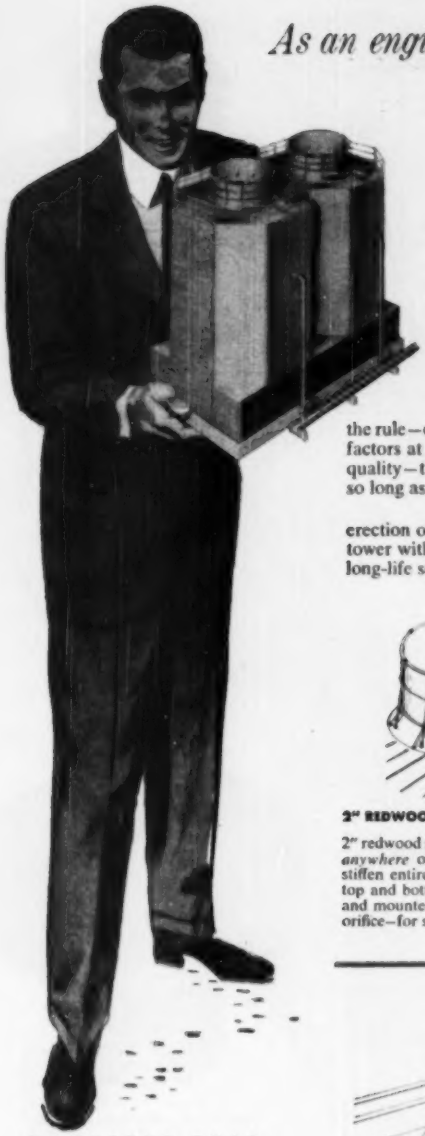
The RUGGED DESIGN inherent in the 1950 FLUOR COUNTERFLO Cooling Tower

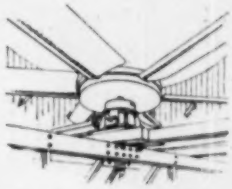


Ruggedness is a prerequisite in cooling tower design and performance. Without it, inefficiency and costly maintenance becomes the rule—drop in plant production is the end result. Regardless of the influencing factors at time of purchase—low first cost, claims of efficiency or statement of quality—the cooling tower you select will meet performance requirements *only* so long as its original structural design endures.

Thirty years' intensive development in the design, fabrication and erection of cooling towers enables Fluor to offer you a better cooling tower—a tower with comparable first cost, the highest obtainable efficiency and rugged, long-life service.

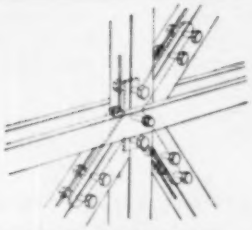
2" REDWOOD IN FAN DECK and STACK

2" redwood supports 1000#/sq. ft. load *anywhere* on deck—heavy enough to stiffen entire structure. Stack is ringed top and bottom with heavy angle iron and mounted on a metal bell-mouthed orifice—for safety and savings in power.



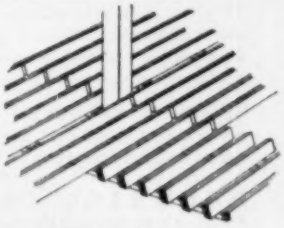
RUGGED GEAR UNIT and FAN BLADES

Gear unit is designed *specifically* for cooling tower service. Result: Less than ¼ of 1% replacement parts!
Heavy Stainless Steel Fan Blades give a larger moment of inertia—tips are strong enough to hold a man's weight.



STRONGER STRUCTURAL DESIGN

Internal gusset plate and bolt-type joints enable structural members to take *both* tension and compression loads—a design *in accordance* with the rigid requirements of major city codes and recent findings of the U. S. Forest Products Laboratory.



1" REDWOOD GRID DECK FILLING

Grid decks consist of heavy 1" redwood nailed individually on sturdy cleats—strong enough for use as scaffolding during tower erection, durable enough to permit repeated removal for cleaning or fire hosing without removing from tower.

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For your protection compare the probable performance of the towers offered before making a decision. Analyze your cooling tower bids thoroughly!

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Technical Papers for Your Files: "COOLING TOWER STUDIES," "COOLING TOWER MAINTENANCE," "EVALUATING COOLING TOWER PERFORMANCE."

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Before your time? Well maybe, but Lagonda cleaners were good medicine for fouled tubes before old Dobbin got auto-conscious. They're even better now. Start one through a coke-laden tube and hear it sing its way all down the tube without a wavering note. That cleaner has reserves of power that it just turns on when the going gets tough. No slowing up and laying down in the hard going. This is the Lagonda quality that is getting stills back on stream everywhere in record time, and keeping refinery engineers happy.

Write for the Lagonda 1100 Series Bulletin, and get full data on these cleaners and their cutter heads. And if you have a tube cleaning job that is holding things up, ask us to arrange a Lagonda demonstration. No obligation.

Elliott

V-259

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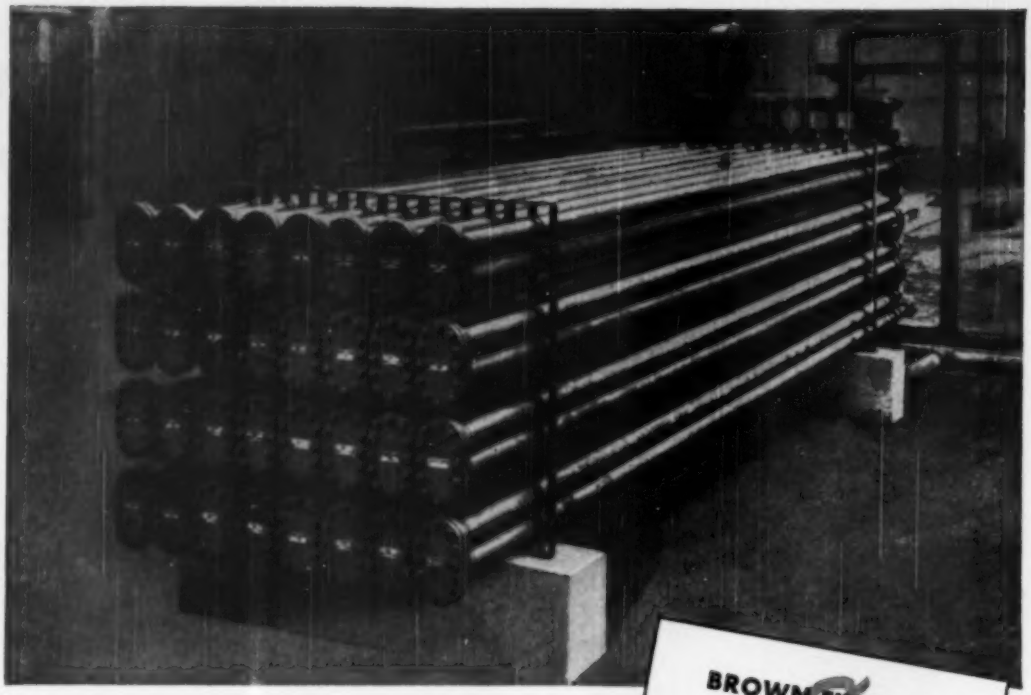

extreme flexibility

Brown Fintube Sectional Heat Exchangers

are easily adaptable to changes in duty

● You'll get almost unlimited flexibility to meet changes in duties, plant re-arrangements, etc., with Brown Fintube Sectional Heat Exchangers. The banks can be changed over *easily* and *quickly*, to operate *efficiently* on almost any *new* and *different* duty. You simply add a few sections, remove a few sections, or change the series-parallel manifolding.

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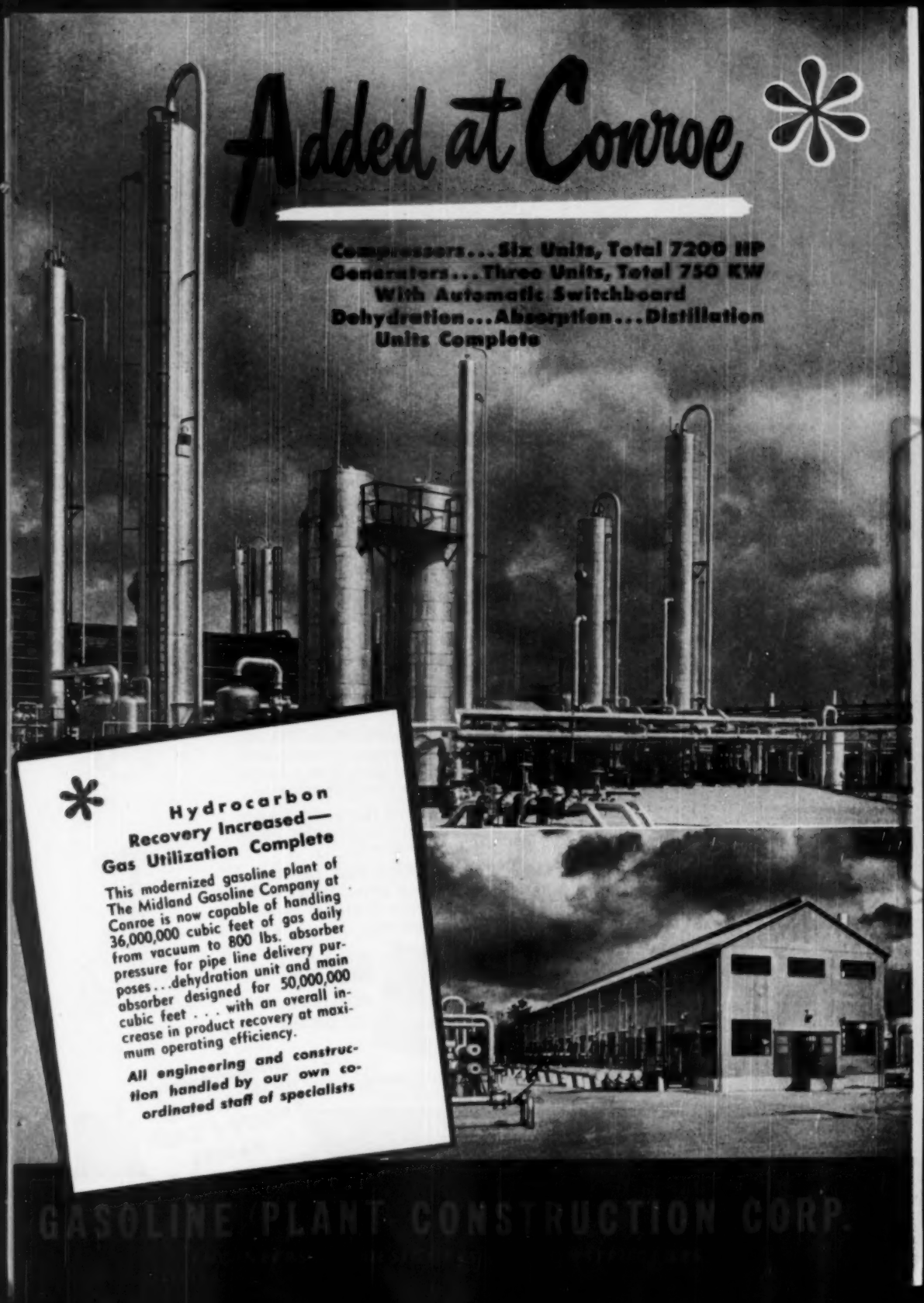
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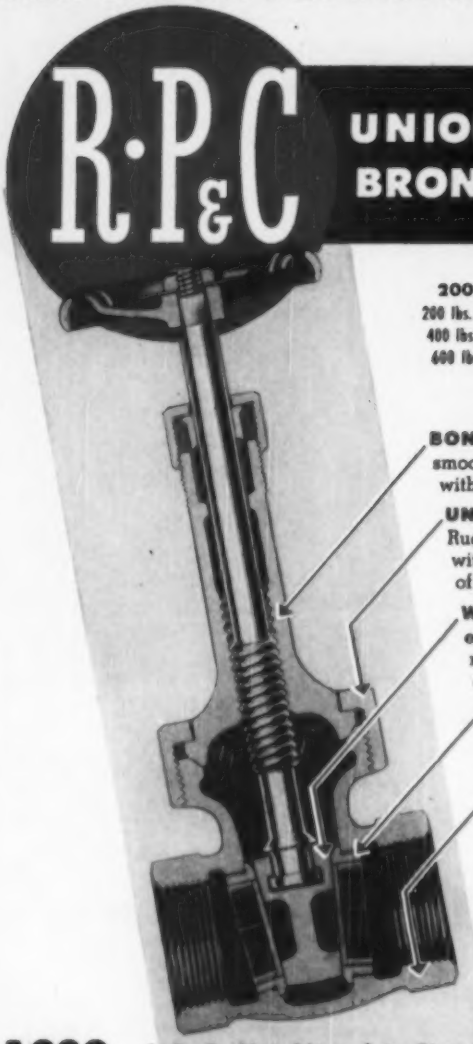

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Send for Bulletin No. 4

Figure No. 733 incorporates all the features found most desirable for sampling operations. It has a surge chamber which eliminates splattering and the inlet flange may be tapped to receive a pipe extension for sampling in zones away from the vessel's side walls. When installed the stem is vertical as a safety and space saving factor.

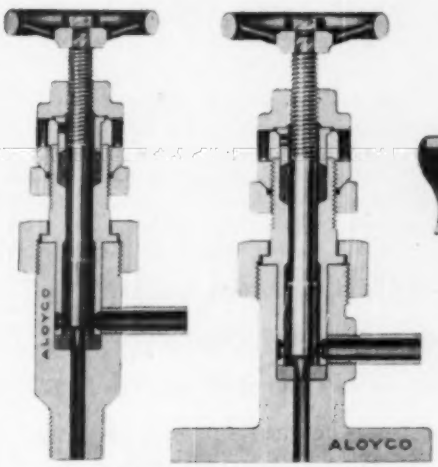
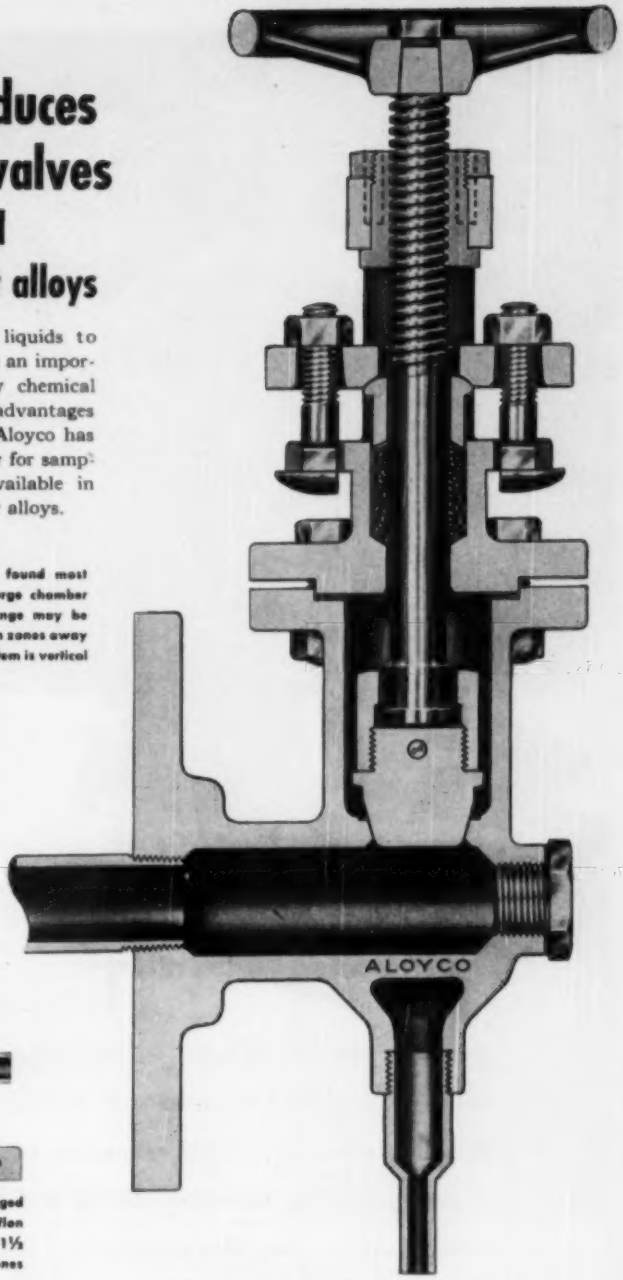


Figure No. 732½ screwed end and Figure No. 731½ flanged end are union bonnet, outside screw valves, with Teflon renewable seats. Stems are in horizontal position. No. 731½ may be provided with a tapped inlet for sampling in zones away from vessel's sidewalls.



Aloyco Valves are manufactured in compliance with the new MSS Stainless Steel Valve Standards S.P.-42.

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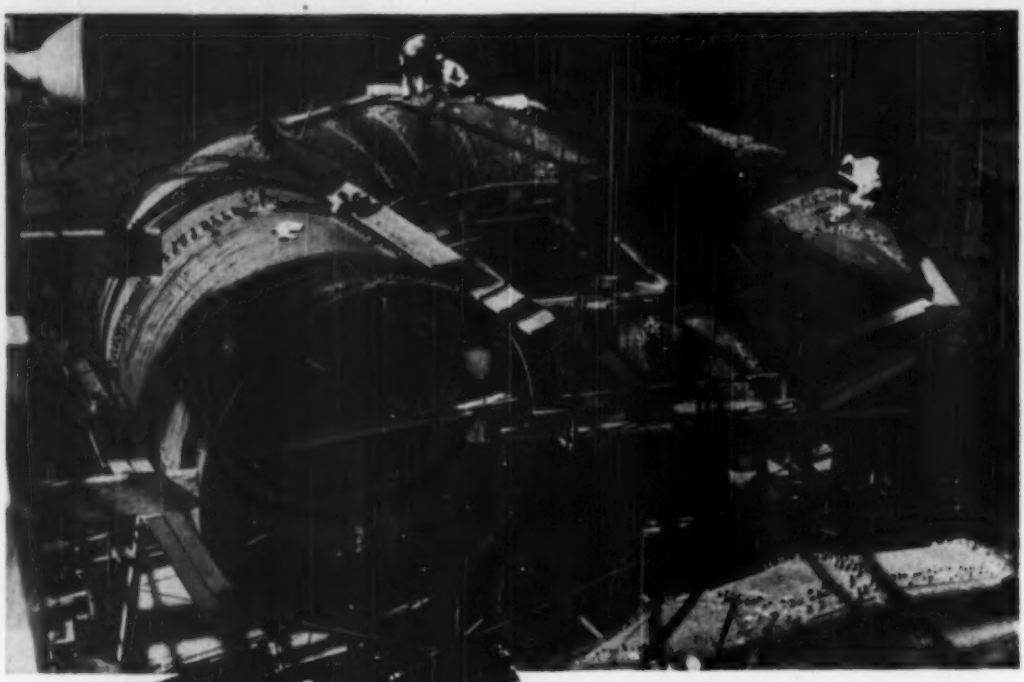

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IN CANADA — ESCO LIMITED, VANCOUVER, B. C.

ELECTRIC STEEL FOUNDRY
2181 N. W. 25th Avenue, Portland 10, Oregon.
Please send dimensional data on ESCO welding pipe fittings.

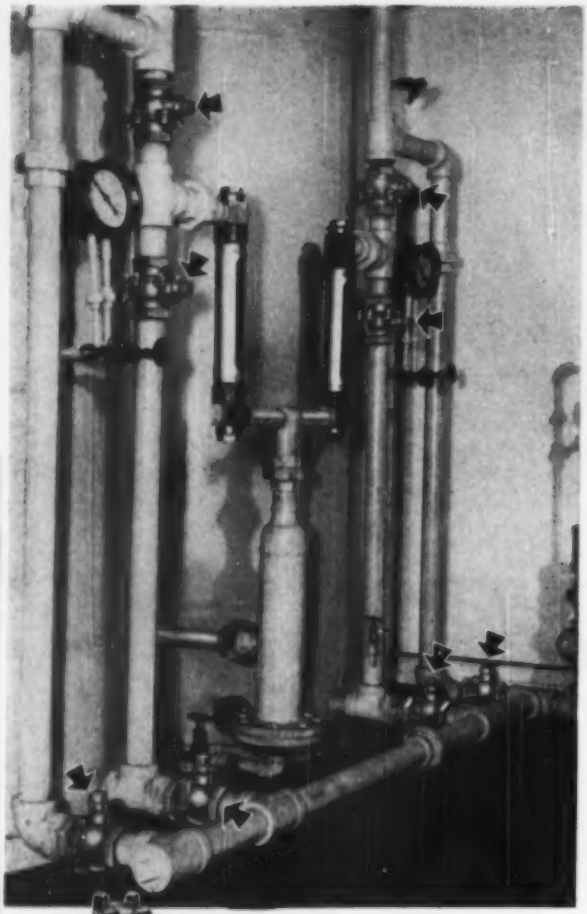
Name_____

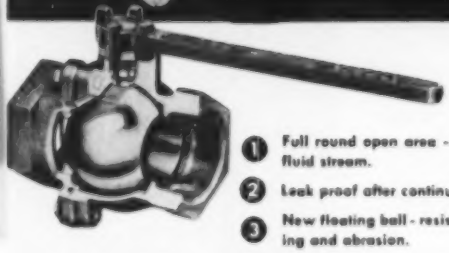
Company_____

Address_____

City_____

Zone_____ State_____





REDUCE

maintenance cost with

ROCKWOOD

BALL TYPE

VALVES

Longer service life with no maintenance is a primary advantage of the Rockwood Ball Type Valve that pays off in dollars and cents year in and year out.

The maintenance engineer of this large gas company was quickly convinced that his choice of Rockwood Valves for gasoline lines on "sweetening towers" had been sound. Says this engineer, "The full *round* flow, leak proof service, easy operation and no maintenance cost make Rockwood Valves far ahead of any competitive valve we used."

Rockwood Valves are today giving excellent performance on difficult operations in oil refineries, food, paper, chemical and rubber plants, etc. It will pay you to specify and buy Rockwood Valves. Send for bulletin V-4. Distributors in all principal cities.

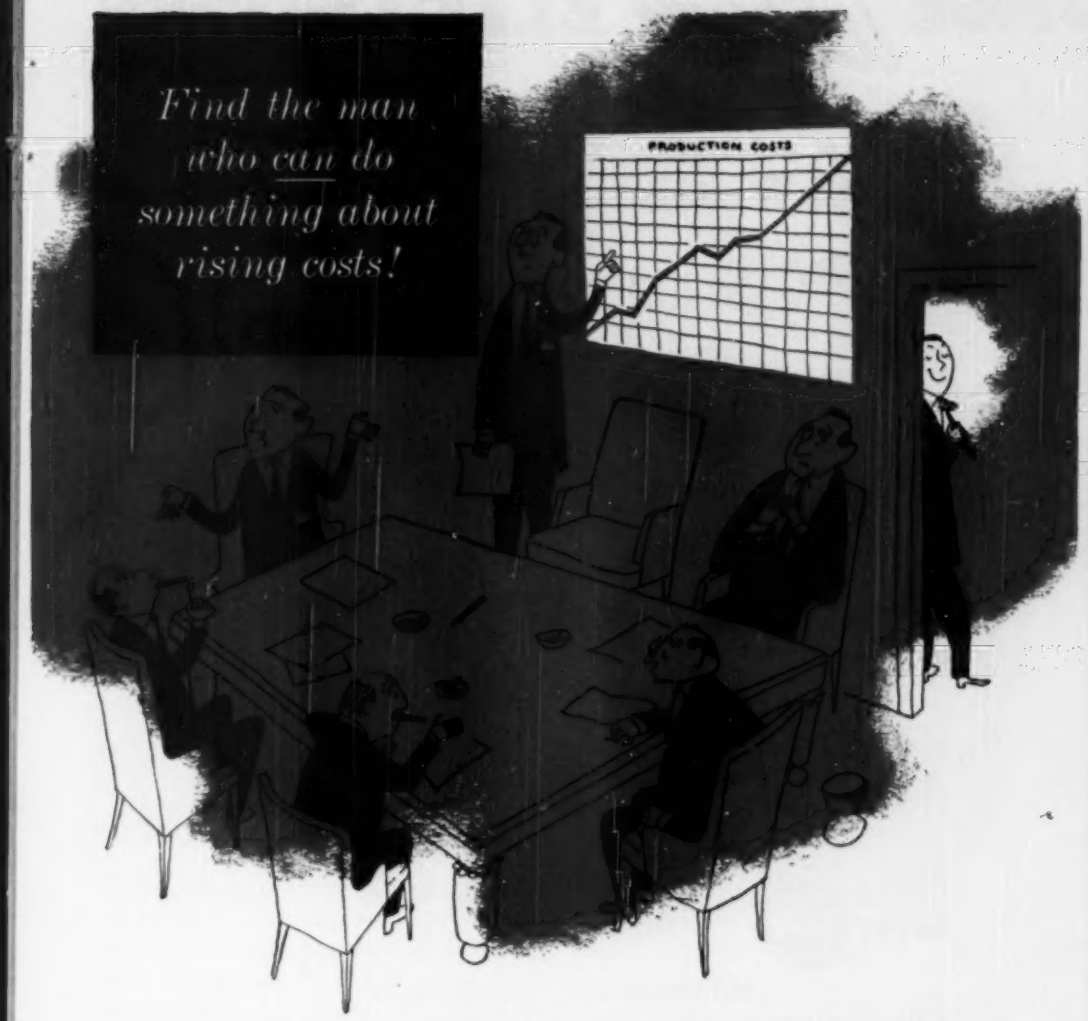
... YOU'LL PROFIT EVERY DAY WITH THESE FEATURES!

1. Full round open area - no turbulence in fluid stream.
2. Leak proof after continued use.
3. New floating ball - resists pitting, scratching and abrasion.
4. No exposed seating surface in open or closed position.
5. Easy to open or close under full pressure.
6. Installed in any position.
7. Quarter turn (90°) opening and closing valve.

Rockwood Valves are recommended for 300 p.s.i. working pressure. Made in bronze with screwed ends in all pipe sizes from ½" to 2".

ROCKWOOD SPRINKLER CO

102 HARLOW STREET WORCESTER 5, MASS



In most businesses, operating costs are still on the rise. But there's *one* man who *can* do something about it—he's the man whose job is to get maximum heat and power from fuel dollars. He knows you *get* maximum efficiency from Eagle-Picher Industrial Insulations because they're made of durable, chemically and physically stable *mineral wool*, noted for its low conductivity. They give long years of service and are easy to maintain and replace.

There's an Eagle-Picher insulation that can help reduce *your* operating expenses!

Let these Eagle-Picher products also save you money . . . power . . . time

Insulating Felts
Supertemp Block • Blankets
Loose Wool • Pipe Covering
Stalastic • Insulseal • Insulstic
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THE EAGLE-PICHER COMPANY

General Offices: Cincinnati (1), Ohio

Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

EAGLE EP PICHER

Since 1843

PAGE *Welding* ELECTRODES

a NEW line of Page-Allegheny AC-DC Stainless Steel Electrodes

they're NEW

... ***BUT*** they've been "given the works" by many large fabricators of stainless steel equipment—on the job. And, from all reports, they're the most all 'round satisfactory electrodes PAGE ever developed for any kind of weld on any type of stainless steel. And PAGE has been making stainless steel electrodes since the early development of stainless.

Ask your Page distributor about these new, improved Stainless Steel Electrodes

ACCO

Monessen, Pa., Atlanta, Chicago, Denver, Detroit, Los Angeles, New York, Philadelphia, Pittsburgh, Portland, San Francisco, Bridgeport, Conn.

PAGE STEEL AND WIRE DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

Get in touch with your PAGE Distributor

how to GET MORE WELDING from your PIPE WELDERS

The exceptional accuracy and uniformity of Midwest Welding Fittings enable the welder to spend more time in welding and less time in preparation. He does not have to struggle to line up fittings and pipe . . . all pipe can be cut in advance according to drawings . . . he need never compensate for inaccuracies. Time and money savings are substantial.

The dimensional accuracy and uniformity of Midwest Welding Elbows result from a unique method of manufacture. These elbows are first made slightly oversize . . . then reheated to forging temperature and brought to final size in compression dies. This assures true circular cross section, uniform wall thickness and accurate radius, included arc and tangents.

Midwest Welding Fittings save you money . . . there is a distributor near you . . . it will pay you to call him.

3710

MIDWEST

PIPING & SUPPLY COMPANY, Inc.

MAIN OFFICES: 1450 SOUTH SECOND ST., ST. LOUIS, MO.

PLANTS: ST. LOUIS, PASSAIC (N.J.) and LOS ANGELES

MIDWEST WELDING FITTINGS Improve Piping Designs and Reduce Costs

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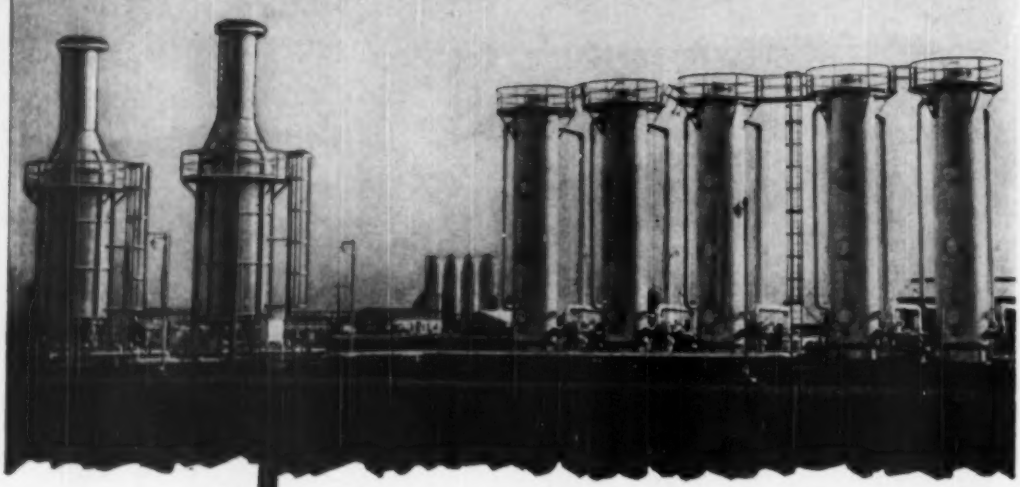
PETRO-CHEM ISO-FLOW PIPELINE HEATERS



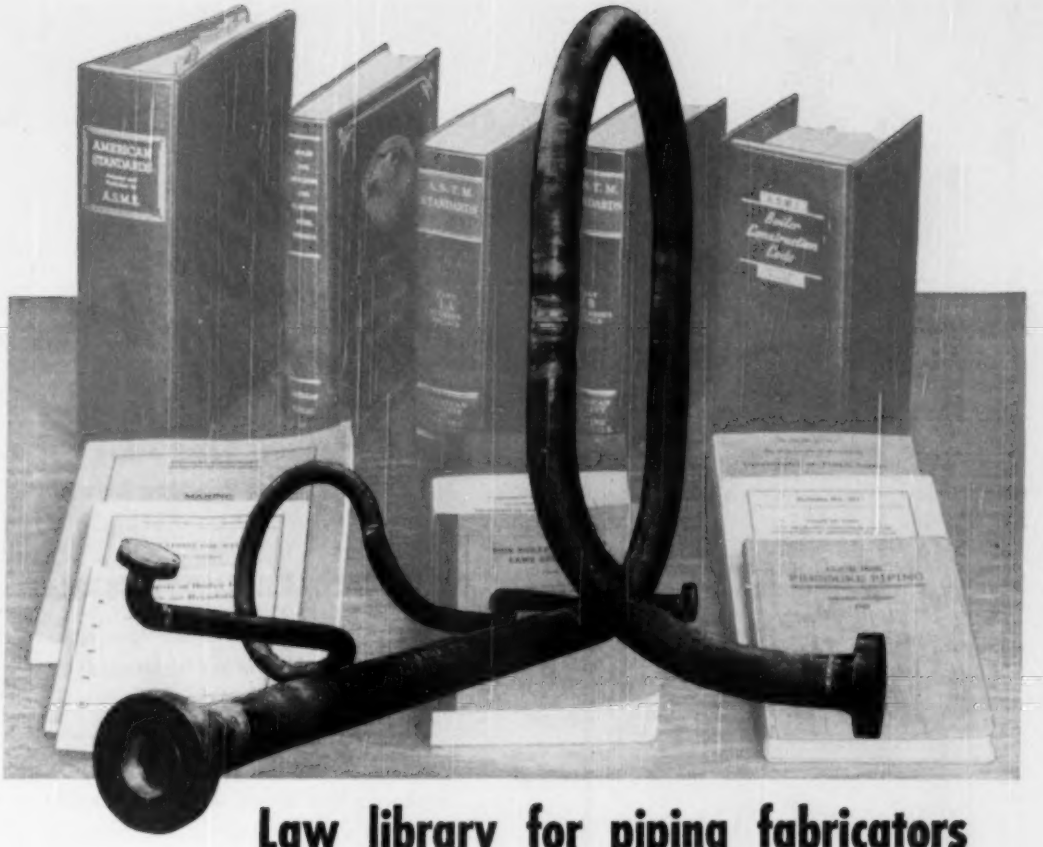
For

- **GAS DEHYDRATION**
  (direct or indirect heating)
- **GAS SUPERHEATING FOR TURBINE DRIVES**
- **VISCOSITY REDUCTION FOR LIQUID FLOW**

PETRO-CHEM
ISO-FLOW FURNACES
UNLIMITED IN SIZE, CAPACITY, DUTY
PETRO-CHEM DEVELOPMENT CO., INCORPORATED
[illegible] EAST 41ST STREET, NEW YORK [illegible] N. Y.

Representatives: Bethlehem Supply, Tulsa and Houston - Flagg, Brackett & Durgin, Boston - D. D. Foster, Pittsburgh - Fowle-Levally, Chicago - Lester Oberholtz, California

There's a Petro-Chem Iso-Flow Furnace and Boiler for every service, capacity or duty, irrespective of temperature pressure ranges . . . none too small or too large . . . more than 600 in operation throughout the world in the petroleum and allied industries performing with utmost satisfaction . . . and in many instances operating in excess of their design capacity by more than 50%.



Law library for piping fabricators

THE safety of your employees, the welfare of the community and a major investment can depend on a single piece of prefabricated piping. That's what piping codes are for . . . state, national, association and insurance codes. You don't have to know these codes because Grinnell engineers know the "law" intimately, check and cross-check with these codes at every step from preparation of detailed drawings and specifications right through bending, welding, stress relieving, heat treating, testing, final inspection, assembly and test runs.

That's just one of the many advantages of having a piping system prefabricated by Grinnell.

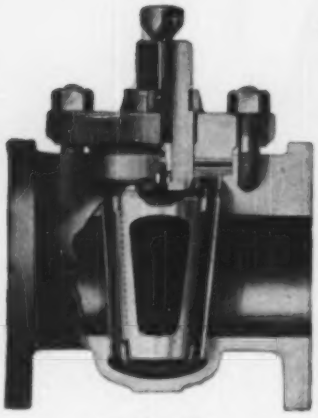
The complete "package" includes interpretative engineering, metallurgical research, compliance with code requirements, manufacturing drawings and specifications, production schedules, purchase of materials, specialized facilities, skilled personnel, control of quality and rigid inspection.

You get this complete package from a Grinnell prefabricated piping plant on schedule, ready for field erection, meeting all code requirements and at a real economy.

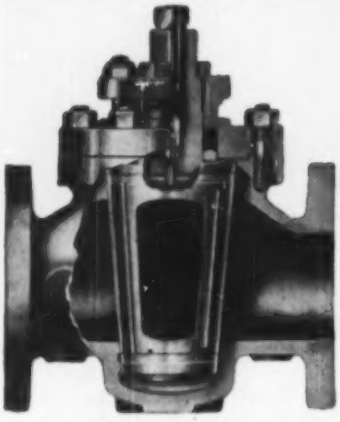
100-ANNIVERSARY
WHEREVER PIPING IS NEEDED

GRINNELL

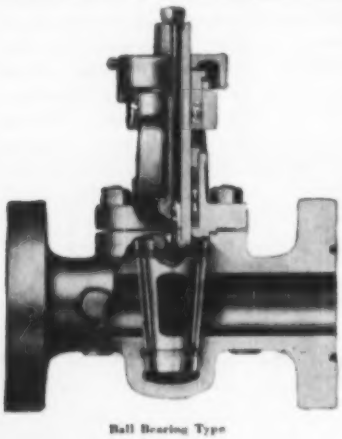
Grinnell Company, Inc., Providence 1, R.I. Warehouses: Atlanta • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane



Single Gland Type



Regular Gland Type



Ball Bearing Type

FOR HANDLING

Acids... Solvents... Sludges...

and other troublesome liquids—

USE WALWORTH LUBRICATED PLUG VALVES

When handling acids, condensates, dyes, oils, solvents, solutions, slurries and hundreds of similar "troublesome" liquids, you get better control, more dependable service and lower operating costs with Walworth Lubricated Plug Valves.

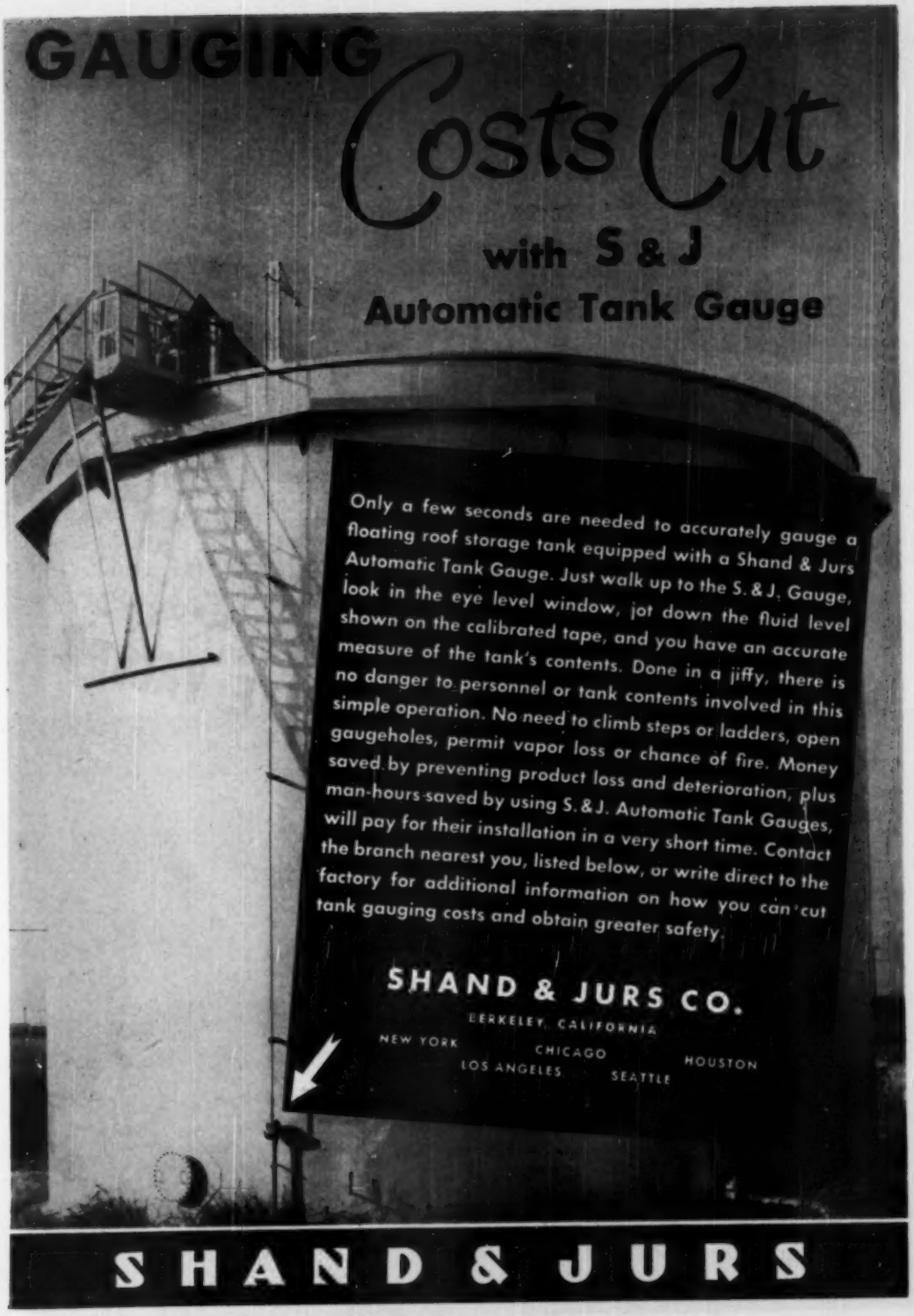
These valves have proved their ability to give easy operation . . . fast action . . . tight shut off . . . greater protection against corrosion. Turning is smooth and easy; just a ¼ turn from full-opening to full-closing. Moreover, Walworth Lubricated Plug Valves are tightly sealed against leaks — *whether open or shut.*

Walworth Lubricated Plug Valves are available in sizes ½" to 26" for pressures from 125 to 5,000 psi, and for vacuum requirement. For further information about Walworth's Complete Line of Lubricated Plug Valves, see your Walworth distributor or write for Catalog No. 46L.

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.


GAUGING
Costs Cut
with S & J
Automatic Tank Gauge
Only a few seconds are needed to accurately gauge a floating roof storage tank equipped with a Shand & Jurs Automatic Tank Gauge. Just walk up to the S. & J. Gauge, look in the eye level window, jot down the fluid level shown on the calibrated tape, and you have an accurate measure of the tank's contents. Done in a jiffy, there is no danger to personnel or tank contents involved in this simple operation. No need to climb steps or ladders, open gaugeholes, permit vapor loss or chance of fire. Money saved by preventing product loss and deterioration, plus man-hours saved by using S. & J. Automatic Tank Gauges, will pay for their installation in a very short time. Contact the branch nearest you, listed below, or write direct to the factory for additional information on how you can cut tank gauging costs and obtain greater safety.
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SHAND & JURS

NEW

SERIES 12100*

FORGED STEEL

DROP

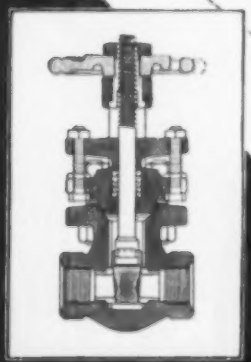
Vogt

BOLTED BONNET
BOLTED GLAND

150-800 POUND

GATE VALVES

SIZES 1/4" TO



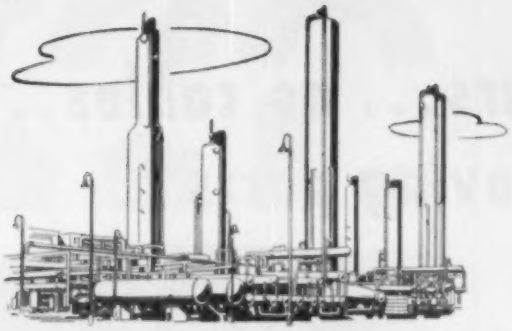
*Series 12100

CARBON STEEL } 800 Pounds @ 750° F.
1500 Pounds Cold Non-Shock

For 150-800 pounds service • Round Bolted Bonnet • Bolted Gland • Gasket or Ground Joint • Outside Screw and Yoke • Renewable Seat Rings • Solid Wedge — Slotted Type • Rising Stem 11½-13% Chrome Stainless Steel Trimmings • Sizes ¼" to 2" inclusive.

HENRY VOGT MACHINE CO. Louisville 10, Ky.

BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • ST. LOUIS • DALLAS



The New Slaughter Gasoline Plant uses PKVG Gas-Engine-Driven Generator Units for supplying ALL ELECTRIC POWER

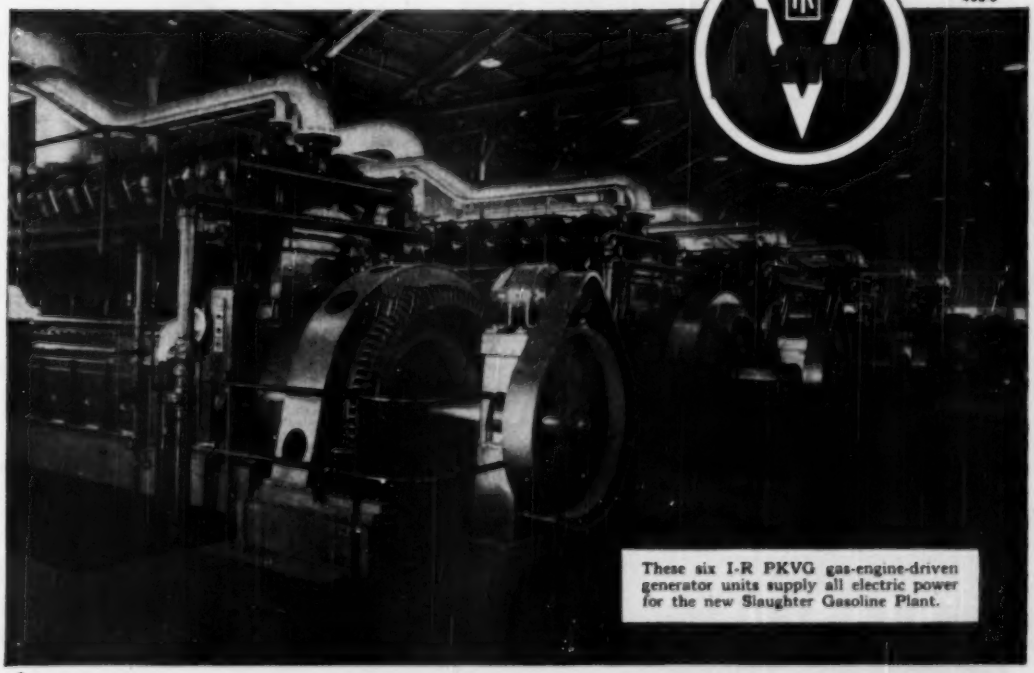
Here, in one of the world's largest high-pressure casing-head gasoline plants at Slaughter Field, Texas, eight companies have united to obtain the most efficient utilization of natural gas. And here—as in so many other petroleum plants the world over—you'll find Ingersoll-Rand 4-cycle gas engines on the job 24 hours a day. Six powerful, economical Type PKVG engines drive six 800-kw, 2300-volt generators that supply all electric power for the entire plant.

For simplicity, efficiency, smooth quiet operation, and rugged dependability, the PKVG has no equal. Ingersoll-Rand 4-cycle, V-design means maximum fuel and lubricating oil economies, and extra stability of power and close speed control at all loads. Simplicity and accessibility of all parts mean easier maintenance —and less of it. Built in 600 to 1320-hp sizes, the PKVG is conservatively rated and will handle any kind of load . . . and so will the smaller PVG, sizes 185 to 407 hp. For complete information, see your nearest I-R representative . . . or if you need gas-powered *compressors*, ask about the JVG, SVG, and KVG, sizes 110 to 1320 hp.

Ingersoll-Rand
11 Broadway, New York 4, N. Y.

COMPRESSORS • AIR TOOLS • ROCK DRILLS • CONDENSERS • TURBO BLOWERS • CENTRIFUGAL PUMPS • OIL & GAS ENGINES

488-6

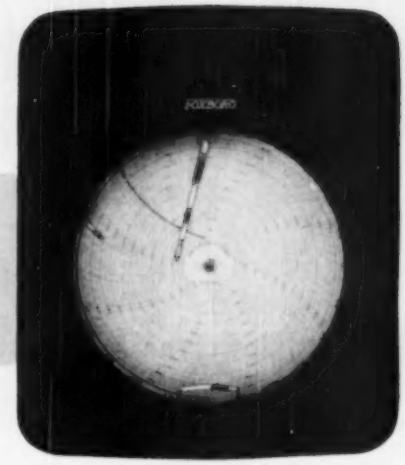


These six I-R PKVG gas-engine-driven generator units supply all electric power for the new Slaughter Gasoline Plant.

WHAT! *no gears... no cables... no fast-moving parts?*

NOT with this electronic potentiometer

. . . because it has NO SLIDEWIRE

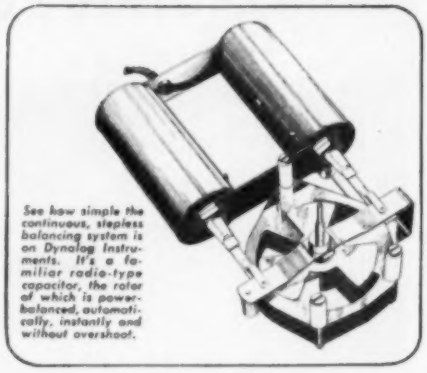


The unique balancing device of Dynalog* Electronic Instruments employs a variable capacitor instead of a slidewire. It is so basically simple that it has only 6 moving parts . . . and only movements of small magnitude are involved. There's nothing to clean, lubricate, adjust, take up or replace. No moving contacts to wear or corrode. Neither dirt, shock, vibration nor ambient temperature can affect its accuracy.

Dynalog balancing is not only continuous but *completely* stepless . . . with sensitivity unlimited by the turn-to-turn steps of slidewire winding. It is so fast that pen or pointer moves full scale to complete balance in as little as 1 second (3 seconds standard).

Dynalog Instruments are available for the measurement and control of temperature (with thermocouples or resistance bulbs), humidity, pressure, flow, force, etc. Complete details in Bulletin 427. Write **The Foxboro Company, 74 Neponset Ave., Foxboro, Mass., U. S. A.**

*Reg. U. S. Pat. Off.



See how simple the continuous, stepless balancing system is on Dynalog Instruments. It's a familiar radio-type capacitor, the rotor of which is power-balanced, automatically, instantly and without overshoot.

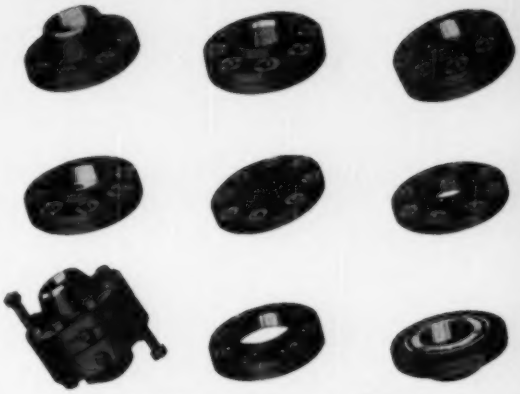
OTHER DYNALOG FEATURES

- **SENSITIVITY** . . . *one ten-thousandth of scale (1/100 of 1%)*
- **SPEED** . . . *full scale to complete balance in as little as 1 second (3 seconds standard)*
- **ACCURACY** . . . *1/400 or 1/4 of 1% of scale • No galvanometer • No batteries to standardize • No maintenance except occasional replacement of standard radio tubes • No knowledge of electronics needed*

FOXBORO
Reg. U.S. Pat. Off.

DYNALOG ELECTRONIC INSTRUMENTS

SEAMLESS WELDING FITTINGS
½-inch through 36 inches
Standard through Double Extra Strong



FORGED STEEL FLANGES
½-inch through 30 inches
150 lbs. through 2500 lbs. pressure

FORGED STEEL FITTINGS
Screwed and Socket Welding
⅛-inch through 4 inches
2000 lbs. through 6000 lbs. pressure

TO MARK PROGRESS

LONG WELDING NECKS
1-inch through 24 inches

LARGE O.D. FLANGES
26 inches through 96 inches

Ladish...one place to get them all

Available in
CARBON
ALLOY
STAINLESS STEELS
ALUMINUM
COPPER
and OTHER
NON-FERROUS
METALS

Whatever the piping job . . . Ladish is prepared to supply your fittings needs. Here is the one line that offers them all . . . Seamless Welding Fittings, Forged Steel Flanges, Forged Steel Fittings, Large O. D. Flanges and Long Welding Necks . . . in an unrestricted selection of types, sizes, weights, pressure ratings and materials. Standardizing on this complete line not only simplifies procurement but also assures you of added dependability by protecting every joint of the system through use of Ladish Controlled Quality Fittings.

A COMPLETE LINE PRODUCED UNDER ONE ROOF
. . . ONE RESPONSIBILITY

LADISH CO.

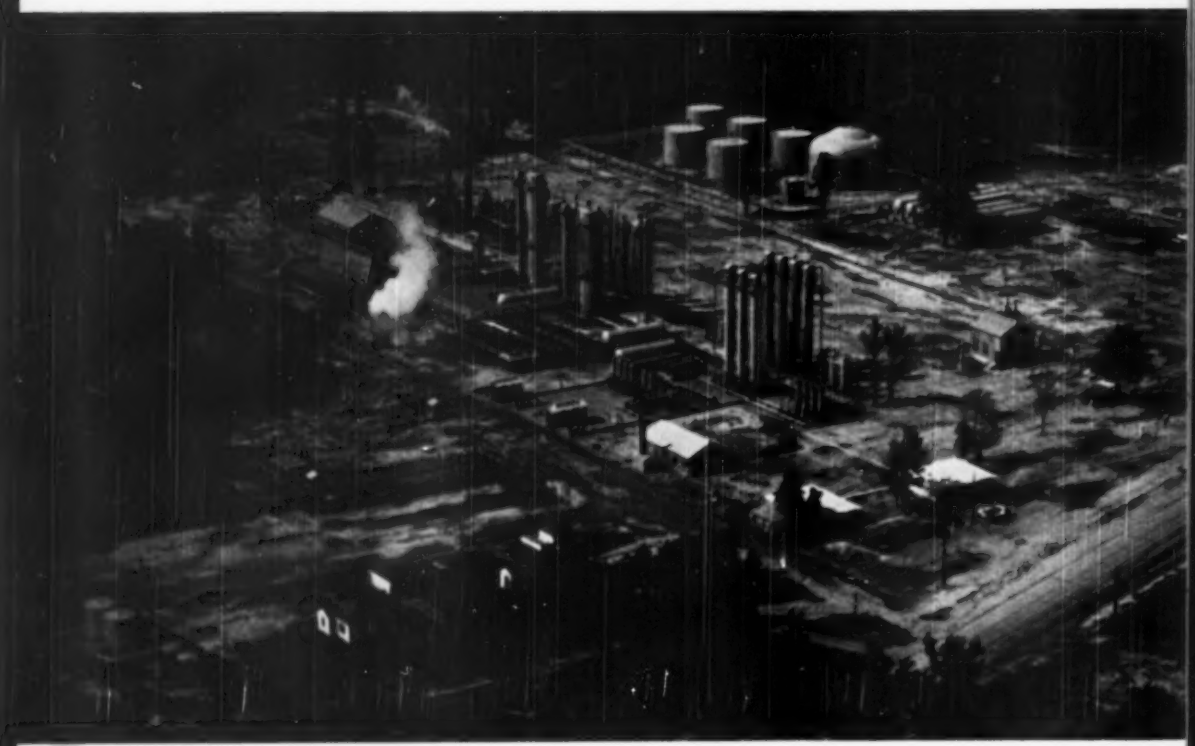
CUDAHY, WISCONSIN
MILWAUKEE SUBURB

DISTRICT OFFICES: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland
Chicago • St. Paul • St. Louis • Atlanta • Houston • Los Angeles

13 in '49

THIS PLANT OF *Carthage Corporation,*

now each day processing over a quarter of a billion cubic feet of high pressure gas from the Carthage gas-distillate field of East Texas, is one of 13 completed by HUDSON and placed in operation during 1949.



From Colorado to Alabama and abroad, at elevations from sea level to a mile, at atmospheric temperatures of minus 40° F to plus 110° F, under process pressures from high vacuum to 8000 pounds per square inch, HUDSON plants are demonstrating to their owners the experience and pride in workmanship which went into their design and building.

HUDSON

ENGINEERING CORPORATION

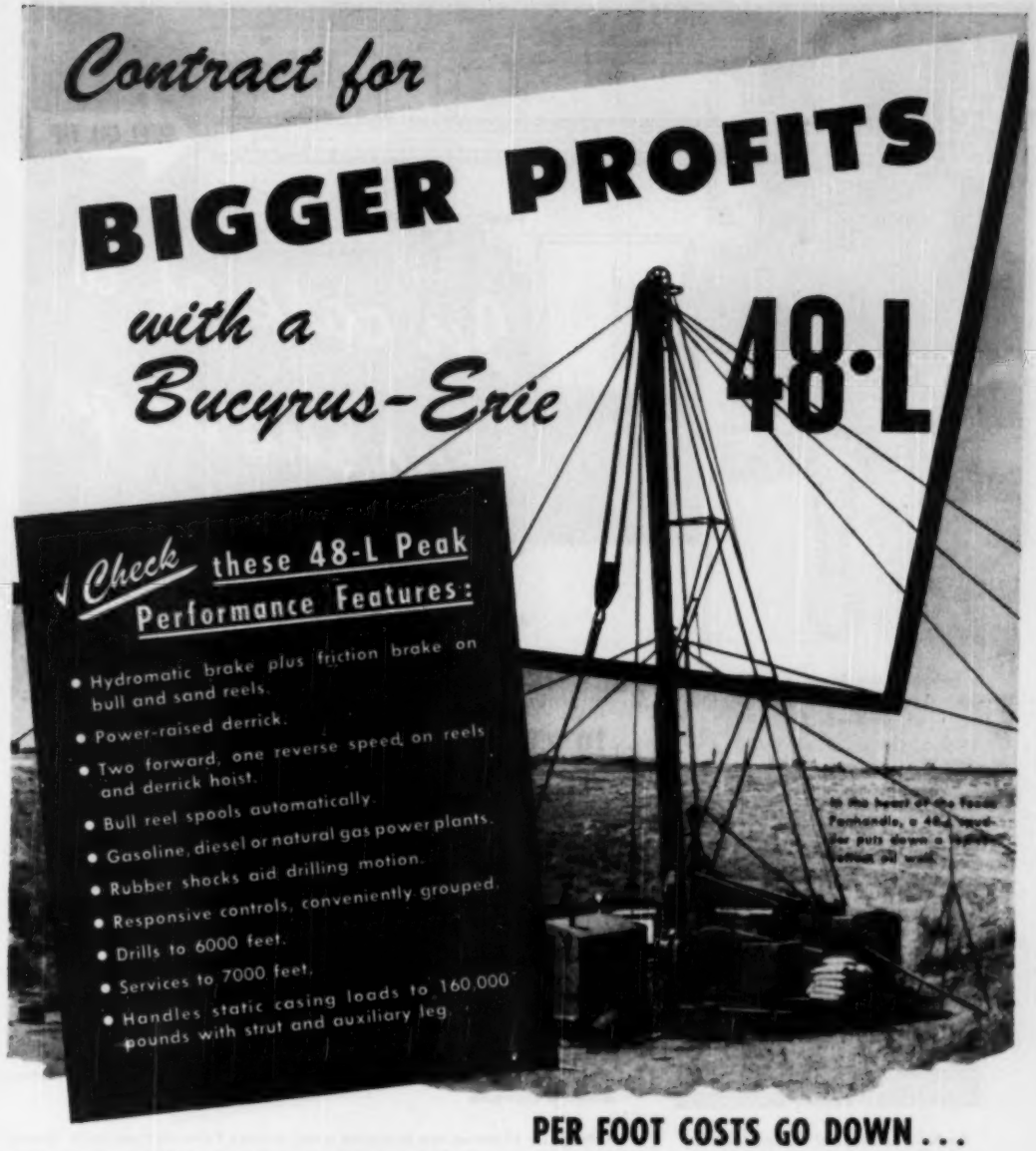
FAIRVIEW STATION • HOUSTON, TEXAS

GAS COMPRESSOR STATIONS • CYCLING PLANTS • GAS DEHYDRATION PLANTS • NATURAL GASOLINE PLANTS • FRACTIONATION UNITS • CRUDE TOPPING UNITS • PRESSURE MAINTENANCE PLANTS • HYDROGEN SULPHIDE REMOVAL PLANTS • ATMOSPHERIC AND VACUUM DISTILLATION UNITS

Contract for

BIGGER PROFITS

with a Bucyrus-Erie **48-L**



√ *Check* these 48-L Peak Performance Features:

- Hydromatic brake plus friction brake on bull and sand reels.
- Power-raised derrick.
- Two forward, one reverse speed on reels and derrick hoist.
- Bull reel spools automatically.
- Gasoline, diesel or natural gas power plants.
- Rubber shocks aid drilling motion.
- Responsive controls, conveniently grouped.
- Drills to 6000 feet.
- Services to 7000 feet.
- Handles static casing loads to 160,000 pounds with strut and auxiliary leg.

LOWER RIGGING AND MOVING COSTS

Trailer or skid mountings give all Bucyrus-Erie spudders cost-saving mobility. Typical is the report of a 48-L owner in Oklahoma who says his 4-man crew can tear down, move to a new location, and be ready to sink a new hole in from four to six hours.

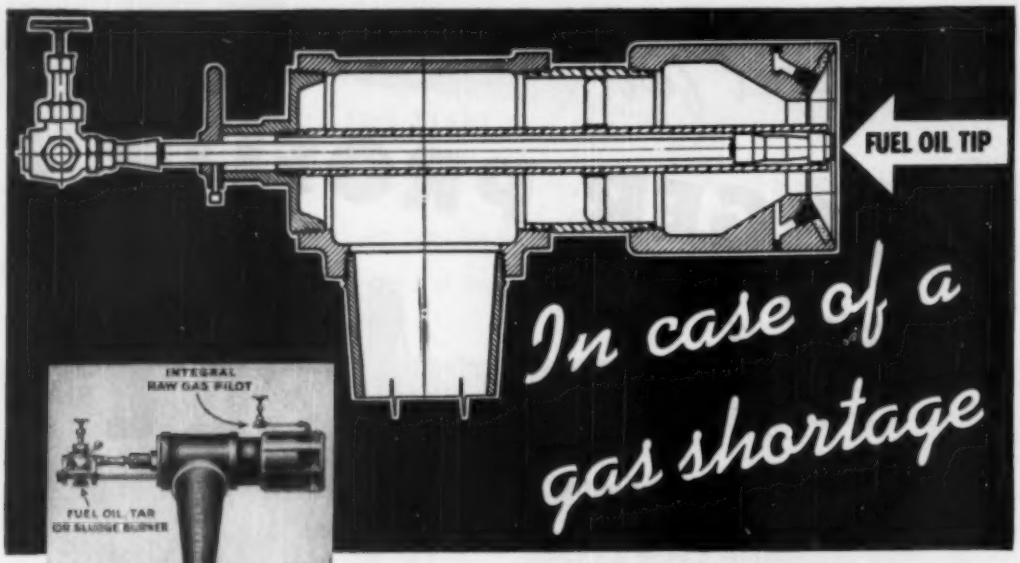
PER FOOT COSTS GO DOWN . . .

. . . with the speedy penetrating action, economical power plants, long-wearing tools, and the large rope-saving sheaves of all Bucyrus-Erie spudders. Investigate the 24-L, 28-L, 36-L and 48-L rigs before you tackle your next job.

Contract for bigger profits by signing up with a new Bucyrus-Erie.

DISTRIBUTORS IN ALL PRINCIPAL OIL FIELDS

BUCYRUS ERIE — SOUTH MILWAUKEE WISCONSIN



An "Airocool" Gas Burner in combination with a Type "S-A-R" Steam Atomizing Oil Burner.

. . . CONVERT

your inspirating gas burners NOW to combination gas and fuel oil

The Patented "Airocool" Nozzle directs the separate igniter flames against the main volume of the mixture, to insure stable ignition, prevents overheating and burning of the castings, and allows greater turn-down without flame burnback.

National Airoil Burner Company has specialized in these conversions for more than 15 years. Our numerous successful oil burner installations are applied to sizes 4, 5, 6 and 8 inch inspirating gas burners of all well known makes, whether in boilers, heaters, stills, dryers or kilns. The above illustration includes a combination of our "Airocool" Gas and "S-A-R" Oil Burners. These installations have patented oil burner adaptors emphasizing such practicable and exclusive design details as:

1. Ease of withdrawing oil burner without shutting off the gas burner.
2. A self-aligning device that insures oil burner always being exactly centered with gas burner nozzle outlet.
3. A positioning collar-handle that keeps oil burner tip in correct predetermined position relative to gas nozzle.
4. Although our oil burners may be applied to any standard flame retention nozzle, there is definite maintenance advantage in using the specially designed "Airocool" flame stabilization nozzle, which long outlasts any other make of nozzle where gas burners are converted to combined gas and oil burners.

Write for detailed description.

NATIONAL AIROIL BURNER CO., INC.

NAB

Main Offices & Factory: **1254 EAST SEDGLEY AVENUE**
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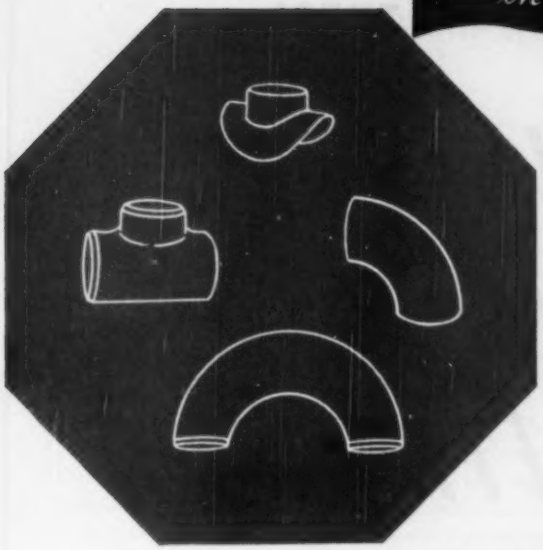
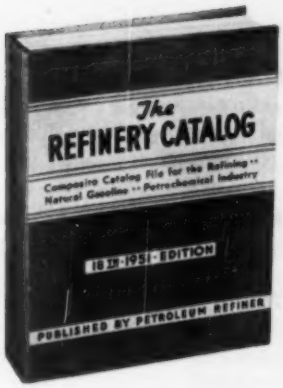
SOUTHWESTERN DIVISION: 2512 SOUTH BOULEVARD
HOUSTON 6, TEXAS

15 Welding Fitting Manufacturers
HAVE THEIR CATALOGS FILED
in Refinery Catalog



EASY-TO-USE GUIDE

For Every Buying Job


The
REFINERY CATALOG
Composite Catalog File for the Refining -- Natural Gasoline -- Petrochemical Industry
PUBLISHED BY PETROLEUM REFINER

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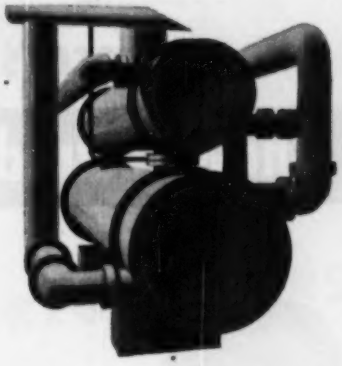

Equipment refining naphtha from certain sour Texas crudes, in a large refinery, was put out of action every 6 weeks due to corrosion from bandit molecules carried over from the fractionator. So, in 1947, coolers and heat exchangers were replaced with equipment using monel-clad steel shells and tube sheets. Today, trouble-free high-profit operation is maintained despite high pressure attack by phenol, hydrogen sulfide, and sulfurous acid.

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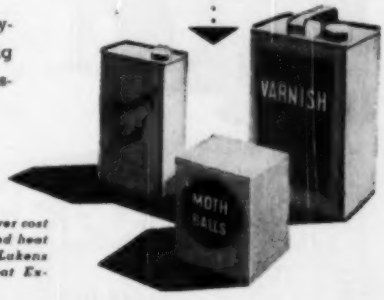

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To provide the required corrosion resistance at a lower cost than with any comparative material, the coolers and heat exchangers shown were designed and fabricated of Lukens Monel-Clad Steel by The Lummus Company, Heat Exchanger Division.

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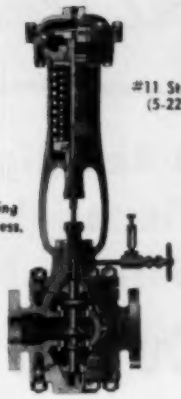
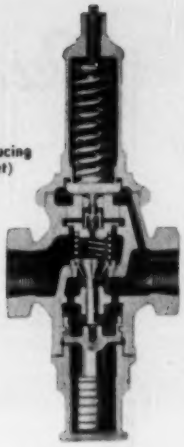
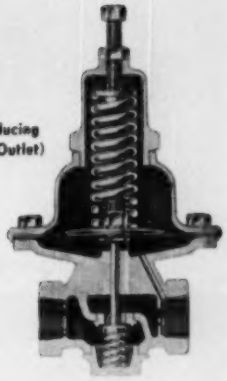


#35 Reducing
#36 Back Press.



#11 Steam Reducing
(5-225# Outlet)



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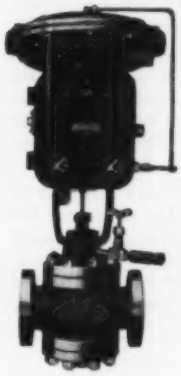

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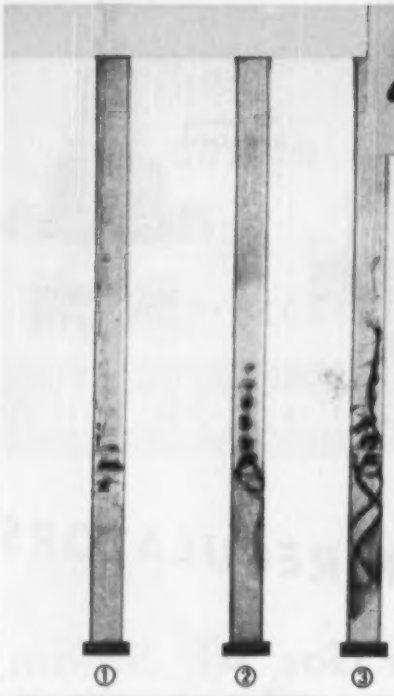

Glass manifolds from single cylinder engine showing deposit forming tendency of dye.
No. 1 operated on .5 gram Oil Blue A/100 gal. gasoline
No. 2 operated on 1.0 gram Oil Blue A/100 gal. gasoline
No. 3 operated on .75 gram Oil Blue/100 gal. gasoline
Even No. 2 with higher dye concentration shows less deposit than No. 3 with previous Oil Blue.

A New High Tinctorial Strength Gasoline Dye...

Du Pont Oil Blue A

Developed Especially for Aviation Gasolines

Another new Du Pont product—Du Pont Oil Blue A is a gasoline dye made to meet the need for a blue dye of high tinctorial strength which can be used in lower concentrations to obtain the desired color intensity. Approximately 35% stronger than the previous Du Pont Oil Blue, it is several times more soluble as well. Du Pont Oil Blue A meets the requirements of Specification MIL-F-5572 and may be used in aviation gasolines intended for military use.

Du Pont Oil Blue A is a single component dye with a free flowing crystalline form which will not lump or cake on prolonged storage, even at elevated temperatures. This feature, coupled with its high degree of solubility, simplifies the preparation of stock solutions or the direct dyeing of gasoline.

The deposit forming tendency of Du Pont Oil Blue A in intake manifolds is considerably less than the former Oil Blue as demonstrated by the glass manifolds shown opposite from laboratory bench tests in single cylinder engines. The lower concentration of dye required to meet established color standards helps greatly to minimize deposits.

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Straight Run Gasoline	760-950
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Aviation Gasoline	570-760
Benzene	28400-32000

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Du Pont Oil Blue A will be used to color Du Pont Tetraethyl Lead Compound, Aviation Mix. In addition, the dye in Du Pont Tetraethyl Lead Compound, Motor Mix, will be changed from yellow to orange, thereby reducing dye solid content by 35%. These dye changes will not require changes in your finished gasoline color formulae.

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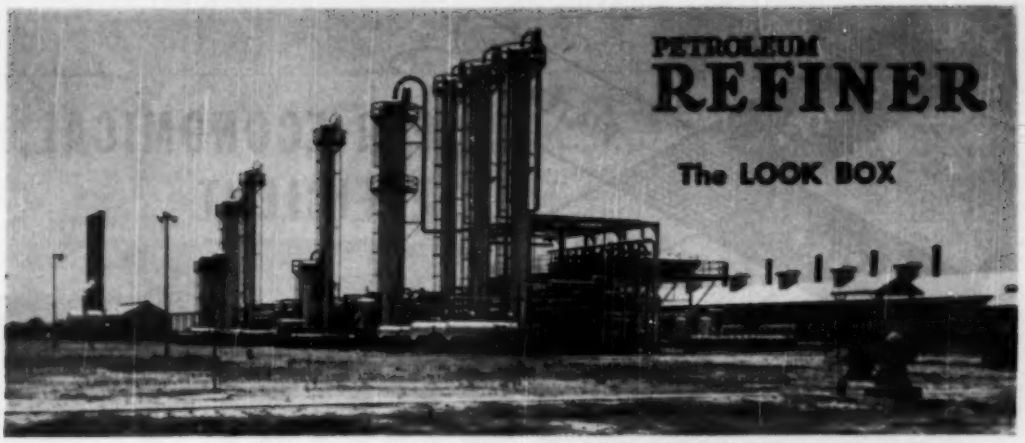


PETROLEUM REFINER

The LOOK BOX

THIS issue of PETROLEUM REFINER includes a section on the processing of light hydrocarbons—a matter of prime importance to natural gasoline plant men that also commands a good share of the time and efforts of refinery men and petrochemical plant operators.

Light Hydrocarbons

Gas processing first reached commercial importance in the oil industry some 40 odd years ago in connection with the recovery of liquid hydrocarbons from natural gas. Primarily the early plants were built for the recovery of gasoline. As new markets opened, new methods of processing were developed. The modern natural gasoline plant recovers butane, propane, and even ethane as liquid products. Early refinery operators adapted the equipment of the natural gasoline plants to the recovery of refinery vapors. Over the years new refinery processes that produce large volumes of gases, have come into use and the recovery plants have enjoyed increasing importance. The presence of these large volumes of cracked refinery gases has led also to the development of a variety of conversion processes by which they are made into high quality gasolines. Today almost all process plant installations in the oil industry have a considerable percentage of their equipment in service for the recovery, fractionation, or conversion of gases—whether the plant feed stock is natural gas or crude oil or some intermediate hydrocarbon for the manufacture of petroleum chemicals.

Several articles here show details of processes and equipment in recently completed plants. A study of these plants provides quite a bit of information concerning the engineering and equipment design that went into their building. It is to be noted that the plants have many features in common. Pumps and compressors and control instruments, for instance, are much the same in general design. So also are the process schemes used in some of the gasoline plants. The sizes of individual equipment components, however, vary over wide ranges. Plant capacities, feed compositions, and product requirements differ in each instance, and each plant is especially designed to best meet a specific set of operating conditions.

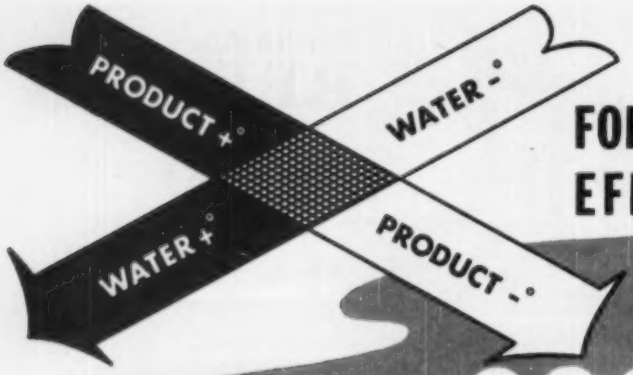
One article reports the installation of a catalytic reforming unit in a gasoline plant—an arrangement that will be repeated in more plants in the not distant future and may become a general trend in the natural gasoline industry. The octane number specification of both premium and regular gasolines continues to rise. Many natural gasoline plants installed TEL blending facilities for use with aviation gasolines during the war. Now many of these plants plus some additional installations are used for the blending of finished motor gasolines at the natural gasoline plants. A serious limitation of such gasolines is the octane number. Currently, most gasoline plants have difficulty in meeting octane number specifications for premium fuels. The conversion processes thus are increasingly attractive.

Interesting mechanical details are to be found in the description of a "refinery type" structure adapted to a gasoline plant application. Such structures allow more compact piping and provide better conditions for pump operation and some improvement in ease of operation for the plant.

An article on the alkylation of propylenes reports one refinery's experience in expanding the use of the sulfuric acid type alkylation process. Highly satisfactory commercial results have been achieved—and since there is more-or-less propylene available in tail-gas streams at most refineries, the new operation may well find wide use.

Gasoline plants having contracts with natural gas pipe lines are commonly operated for the

Top of page photo—The Tomoconnor gasoline plant near Refugio, Texas, a conservation project, is owned jointly by Humble Oil & Refining Company and Quintana Gas Company. The plant, operated by Humble has a design capacity of 35,000,000 cubic feet daily of casinghead gas. Residue gas, dehydrated, is delivered to a gas transmission pipeline.



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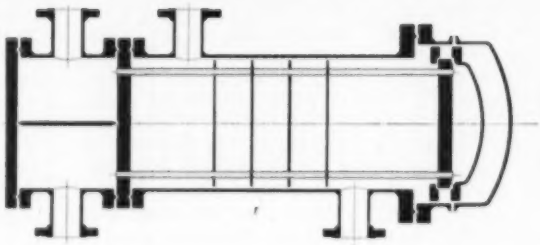

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production of an absorber tail gas having some specified minimum heat value. An article reports the operation of a new Magnolia gasoline plant which utilizes an automatic calorimeter as the controller that sets absorber operation.

Common practice in the erection of fractionating towers in recent years has provided for the shop fabrication of heavy and fairly complex lifting lugs as an integral part of the pressure vessel. A simpler system has been devised and used in the erection of gasoline plant towers. The system utilizes a pair of special openings having bolted cover plates. The covers are removed for vessel erection use and a lifting beam of circular cross section inserted through the vessel.

Another Co-op Advantage

IN A REPORT dated January 27, 1950, the National Patent Council, Gary, Indiana, comments as follows:

"Our United States Patent System has weathered many storms during the 110 years of its existence. Down through those years it has stood as the immovable rock on which our fabulous industrial growth has been founded.

"The right of the inventor to profit from his invention through patent protection has provided the incentive to create new machines, new processes, and improvements over old methods.

"A patent grant has been generally accepted by the courts as a property right of the inventor for a limited time. During the 17 years of private ownership the patent has the same legal protection for its owner as that of any other privately owned property.

"During the current march toward statism political aspirants are seeking to undermine that protection. Consider the Celler Committee, investigating 'Monopoly power,' now trying to bring out testimony in its hearings that the patent owner is a 'monopolist.'

"Representative Emanuel Celler (D.—N. Y.), chairman of the committee, tried repeatedly at one hearing to get the Secretary of Agriculture to support the proposal that there should be 'something in the nature of compulsory licensing of patents to farming groups, particularly to the co-operatives.'

"Secretary Brannan admitted he never had thought of such a thing but considered such matters were appropriately within the province of the Department of Justice. Chairman Celler replied that he was not referring to the 'abuses of the patent processes.' He said his question concerned 'whether or not those patent processes should be opened to a greater degree, beyond the monopoly use of the patentee.'

"This specific inquiry was aimed at processors of prepared foods. Many thousands of workers are employed in the industrial plants where farm products are processed. Stability of operations in these plants is in a large measure dependent upon machines and formulae protected by patents. These manufacturers surrender a large share of their earnings in taxes. Co-operatives pay no taxes.

"Compel manufacturers to license their patented processes to any competitor and you have destroyed all incentive to invent new things to make new jobs.

"This proposal to give co-operatives another unfair advantage is but one example of the thinking of politicians who stop at nothing to befuddle voters—in this instance the farm vote.

"Break down this one barrier of patent protection and a flood of other schemes for compulsory licensing would crowd through the same gap."

Misleading Data On Oil Shale

CLAIMS made by the U. S. Bureau of Mines that motor fuels could be made from oil shale for 9 cents a gallon have been termed "misleading" by A. L. Solliday, executive vice president of Stanolind Oil and Gas Company. He charges that the government is confusing the public by basing its cost figures for synthetic fuels on calculations that are sometimes "no more than wishful thinking."

Solliday, whose company has conducted extensive scientific work on synthetic gasoline for nearly a decade, sharply criticized features in the annual report of the Secretary of Interior, which contains Bureau of Mines cost figures on the manufacture of synthetic liquid fuels. According to the Bureau of Mines, jet, diesel and residual fuels could be manufactured from oil shale for 9 cents. The industry has indicated that it would cost 22.5 cents to make gasoline from shale.

Calling the Bureau's estimates "misleading to the American people," Solliday said that the industry and government figures were not comparable. He stated that:

1) The Bureau's figures leave out the cost of housing workers at remote mining areas and the cost of transportation of products from the mine to a market area;

2) The Bureau has computed its cost on low premium products such as jet, diesel and residual fuels which have little market value or demand, whereas industry has based its cost on high premium motor gasoline;

3) The Bureau allows too low a return on capital investment—only 3 percent—in spite of the great risk involved in such a venture;

4) The Bureau puts capital investment at unrealistic low levels.

To enable the public to judge whether synthetic fuels represent a sound or unsound investment, he said the Bureau should publish detailed breakdowns of all its economic calculations including investment costs. "Until the Bureau does so, the public will continue to read conflicting reports about the cost of synthetic fuels. The end result will be confusion on this vital subject—confusion which we as a nation cannot afford."

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This new 1950 Catalog contains 16 pages illustrating and explaining the many specialized techniques and services of the Nooter Corporation in the fabrication of tanks and vessels for the petroleum and processing industries. "Beyond Your Blueprints" also features an extensive section of valuable Corrosion Data Charts showing resistance of commonly-used metals to hundreds of chemicals.

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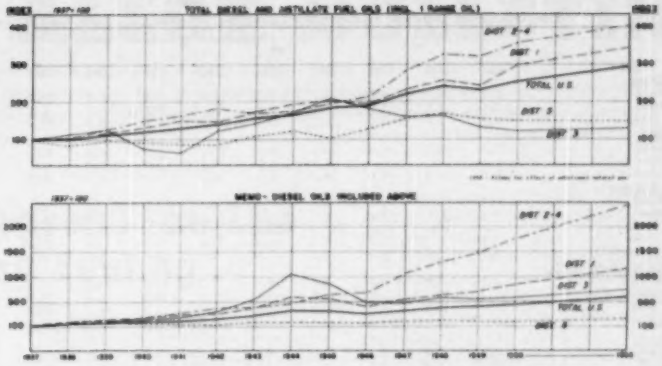
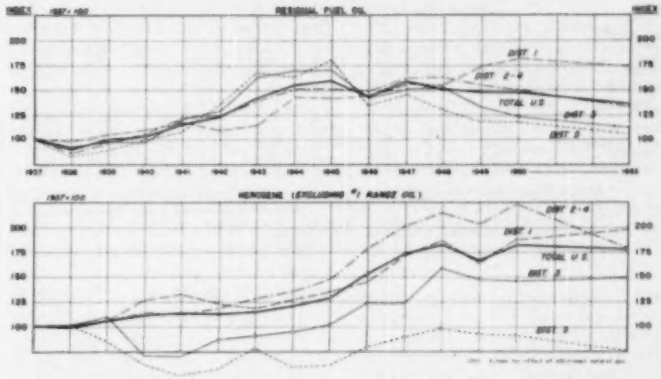
***THIS CONDENSATION** of a thorough study on fuel oil markets shows trends that may be surprising to many refinery men. The author, an economist with the Socony-Vacuum Oil Company, has long experience in the prediction of petroleum product demands, however, and the editors believe that this prediction is as reliable as the nature of such efforts permit.*

Space limitations prevent the publication here of all the statistical data that were assembled for the study. Rather, figures for U. S. totals have been included and quite a bit of the statistics by districts omitted. A study on the effects of weather on petroleum consumption and a listing of gas pipe lines were also omitted. Those who really want to closely follow the effects of weather, as well as those who want the detailed statistical material from which this article was prepared, can obtain copies of the complete study from the author, 26 Broadway, New York. The original study was presented last month, first as a talk before the Western Petroleum Refiner's Association in San Antonio.



Graphs 1 (top) and 2—Trends of Fuel Oils Used by Districts in the United States



Graphs 3 and 4 (bottom)—Trends of Fuel Oils Used by Districts in the United States

Fuel Oil Markets— Past and Future

ALBERT J. McINTOSH
Socony-Vacuum Oil Company, New York

THIS IS a most appropriate time to make a study on the trends of consumption of petroleum fuel oils and kerosine and to speculate about the outlook for their future use. Our industry is beginning to be geared more and more to these fuels rather than to gasoline which since 1912 has been the product of major importance. Also the impact of natural gas on the future consumption of these liquid petroleum fuels is of increasing concern and a matter about which too little data or information has been available.

This study involves a volume of material, that includes (a) A detailed study from 1937 of uses of liquid fuels by districts and by classifications of users and forecasts for 1950 and 1953. (b) Three schedules on new natural gas pipe lines. (c) An estimate of the displacement that natural gas will make on liquid fuels markets. (d) Calculations of the effect of weather on the consumption during the past four years. (e) The effect on consumption of a change of one degree day from normal.

History and Forecast

Tables 1 and 2 contain the history of the use of liquid petroleum fuels since 1937 in the United States by classifications of users.

The year 1950 has been forecast, taking into consideration normal weather for the balance of the year and those changes in trends which we find evident today. The 1953 forecasts on these tables do not reflect the utilization of additional natural gas. We have shown the effect of natural gas on separate schedules which we will introduce later. This analysis was made possible by the annual reports made by the Bureau of Mines.

Now let's see what these trends indicate. Graph 1 shows the trend since 1937 in the use of all diesel and distillate fuel oils and where these lines may be in 1953 after allowing for the effect of additional natural gas. Districts 2 and 4 (the Central and Rocky Mountain states) have had a great rise since the end of the war while District 3 (the Gulf Coast states) and District 5 (the Pacific area) show declines and have had erratic courses due to military and export variations. In spite of natural gas we believe that distillates will continue to increase in District 1 (the East Coast area).

Diesel oils are shown below, Graph 2, and have a considerable influence on the totals just reviewed. Here all districts continue to show increases of considerable magnitude. Please note that the scale used is five times the scale above.

Now turning to residual fuel oils in

Table 1

Consumption of Distillate Fuel Oils (Including No. 1 Range Oil), Total United States (1950 and 1953 Forecast).

(Thousands of barrels daily)

Use	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949[3]	1950[3]	1953[3]
Railroads															
Diesel	1.7	2.2	2.9	5.0	7.5	11.8	17.0	22.7	33.0	41.1	56.1	78.1	100.6	126.0	208.5
Other	2.8	2.5	3.3	3.7	4.0	4.0	4.6	4.2	4.6	7.1	8.6	6.6	6.6	6.6	6.6
Total	4.5	4.7	6.2	8.7	11.5	17.8	23.6	28.9	39.6	48.2	64.7	84.7	107.2	132.6	215.1
Vessels															
Diesel	37.0	35.9	38.6	35.5	29.0	23.1	28.7	34.8	36.7	30.5	37.2	37.5	35.9	35.6	35.6
Other	-	-	-	0.7	1.1	1.2	1.6	1.2	2.1	2.5	2.4	2.1	2.3	2.2	2.2
Total	37.0	35.9	38.6	36.2	30.1	24.3	30.3	36.0	38.8	33.0	39.6	39.6	38.1	37.8	37.8
Gas & Electric															
Diesel	2.7	3.5	4.2	4.5	5.0	5.5	6.0	7.1	8.4	10.4	19.3	20.0	19.4	20.6	21.9
Other	5.4	6.6	7.2	8.0	9.1	10.1	10.3	8.9	10.3	18.6	19.5	20.6	19.7	18.9	21.6
Total	8.1	10.1	11.4	12.5	14.1	15.6	16.3	16.0	18.7	29.0	39.0	40.6	39.1	39.5	43.5
Gas	5.98	7.98	8.3	9.4	10.1	11.2	11.7	11.0	13.68	20.1	29.2	32.2	31.3	30.6	21.9
Electric	2.18	2.18	3.1	3.1	4.0	4.4	4.6	5.0	5.38	8.9	15.8	18.4	17.8	18.9	21.6
Smelting, Mining & Mfg.															
Diesel	4.3	3.8	4.0	5.3	8.8	11.3	13.5	15.8	16.5	20.3	27.3	34.6	34.3	35.6	39.7
Other	11.3	10.5	13.0	14.7	19.6	20.3	28.0	31.4	35.7	38.1	39.8	47.2	47.2	43.1	43.6
Total	15.6	14.3	17.0	20.0	28.4	34.6	41.5	48.4	52.2	58.4	67.1	81.8	81.5	78.7	83.3
Heating	202.6	205.7	206.1	215.6	231.3	218.88	208.4	206.3	232.4	282.6	488.6	546.5	512.1	630.4	764.2
Military															
Diesel	0.6	1.8	3.0	3.0	9.7[2]	23.3[2]	90.3[2]	90.3	62.9	18.9	13.0	19.8	15.6	15.6	15.6
Other	1.5	0.4	0.6	0.8	2.1[2]	21.7[2]	41.2[2]	27.0	20.1	8.1	4.0	3.0	4.9	4.9	4.9
Total	1.8	2.2	3.6	3.8	11.8[2]	45.0[2]	91.5	117.3	83.3	27.0	17.0	22.8	20.5	20.5	20.5
Oil Company															
Diesel	0.4	0.4	0.5	0.6	0.6	0.8	0.5	0.7	0.6	0.9	1.2	1.1	1.1	1.1	1.1
Other	1.6	2.1	1.7	2.3	2.4	2.2	1.9	2.0	2.5	4.7	4.9	8.0	4.1	4.1	4.1
Total	2.0	2.5	2.2	2.9	3.0	3.0	2.4	2.7	3.1	5.1	6.1	9.9	5.2	5.2	5.2
Miscellaneous															
Diesel	13.4	10.5	12.2	13.5	14.3[2]	16.4[2]	18.6[2]	21.4	23.9	26.0	37.1	38.6	39.7	41.1	45.2
Other	7.7	7.9	13.6	14.8	16.2[2]	22.7[2]	20.4[2]	19.7	22.2	23.8	24.4	28.8	21.9	23.3	25.2
Total	21.1	18.4	25.8	28.3	30.5[2]	39.1	39.0	41.1	46.1	49.8	61.5	67.4	61.6	64.4	70.4
#1 Range Oil	7.5	8.0	8.8	10.9	12.2	13.6	16.1	18.1	20.5	23.2	31.9	37.0	32.9	34.3	38.4
All Uses															
Diesel	60.0	58.1	65.4	67.4	74.9	92.2	134.6	151.9	182.0	148.1	191.4	229.7	266.6	275.6	367.6
Other	259.6	263.7	314.3	321.5	400.0	419.6	434.5	419.8	452.6	508.2	625.1	699.6	646.6	745.8	910.8
All Domestic Uses	319.6	321.8	379.7	430.9	474.9	511.8	569.1	611.7	634.6	656.3	816.5	929.3	893.2	1 021.4	1 278.4
Exports	62.5	61.2	87.7	52.3	46.4	29.1	68.4	79.0	98.7	80.8	82.0	58.2	33.4	24.0	18.0
Total Uses	382.1	383.0	467.4	483.2	521.3	540.9	637.5	690.7	733.3	737.1	898.5	987.5	926.6	1 045.4	1 296.4

1942 Military estimated with a portion deducted from Heating, and balance from Miscellaneous.
1946-7-8 Military increased to allow for Imports while Miscellaneous duced the same quantities.
1949 All uses estimated. Totals agree practically with Bureau of Mines calculations.
1950 All forecasts, including estimated effect of gas.
1953 All forecasts, but exclude effects of additional natural gas supplies. See schedules for assumed displacement caused by natural gas.

Graph 3, you can see the different trends since the war's end. District 1 continued to increase and made rapid advances in 1949 and we anticipate some additions during 1950. All the other districts declined in 1949 and we anticipate their continual decline until 1953 along with District 1.

Kerosine, Graph 4, after the war, had a remarkable advance due to tremendous sales of space heaters and other convenience devices. In 1949 there was a large decline which is hard to explain, but in recent months fairly sizable increases have been again experienced. The trend from 1950 reflects our ideas of the different impacts of natural gas on these markets. Districts 2 and 4 also reflect the impact of liquefied petroleum gas as well as natural gas on consumption of kerosine.

In order to see some of the kinds of uses for which these fuels are sold we included three more graphs, A, B, and C. These have been prepared to indicate customer use of petroleum products. The classes of users that have provided our expansion and that account for our

Table 2

Consumption of Residual Fuel Oils and Kerosine (excluding No. 1 Range Oil), Total United States (1950 and 1953 Forecast).

(Thousands of barrels daily)

Use	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	Est. 1949	Est. 1950	1953*
RESIDUAL															
Railroads	186.0	153.7	167.0	177.4	220.7	274.0	318.5	312.8	307.7	274.6	267.2	244.8	195.3	190.3	109.9
Vessels	196.0	167.5	178.4	168.1	155.2	109.7	170.5	251.7	275.1	241.5	279.0	261.5	241.7	239.0	237.0
Total Gas & Electric	64.4	65.5	76.5	77.2	98.2	76.8	84.6	94.2	94.6	139.6	169.0	149.1	124.0	239.0	262.0
Gas	28.42	30.42	31.9	34.6	35.1	37.6	38.6	43.5	46.5	50.9	57.4	62.6	60.0	60.0	60.0
Electric	36.08	35.18	44.6	42.6	57.1	39.2	46.0	50.7	48.1	88.7	109.6	92.5	164.0	179.0	202.0
Smelt., Mining & Mfg.	189.3	150.1	166.8	181.9	214.0	231.5	230.5	236.8	249.8	271.3	315.6	322.0	328.8	328.8	328.6
Heating	97.0	98.4	107.2	122.7	127.5	130.0	117.0	110.6	130.2	136.3	154.5	157.8	136.5	183.7	302.3
Military	24.1	30.1	30.6	43.1	70.5	155.0	254.1	276.9	267.0	102.3	66.0	69.2	46.5	46.5	46.5
Oil Company(Incl.Crude)	119.2	116.8	132.3	138.9	148.4	123.0	139.0	151.2	157.1	159.1	163.1	149.9	164.3	164.3	181.0
Miscellaneous	18.9	13.5	13.7	14.9	15.3	16.5	17.6	12.3	14.2	9.7	13.7	13.4	16.3	16.4	16.4
All Domestic Uses	890.9	795.6	872.5	923.8	1 043.8	1 110.5	1 321.8	1 446.5	1 485.7	1 334.4	1 428.1	1 371.7	1 253.4	1 360.0	1 367.7
Exports	41.7	49.1	47.7	44.0	38.7	33.1	(Incl.in Bun. probably under 25 bbl/y)				29.4	35.6	33.6	26.0	20.0
Total Uses	932.6	844.7	920.4	967.8	1 082.5	1 143.6	1 321.8	1 446.5	1 485.7	1 334.4	1 455.5	1 407.3	1 287.0	1 386.0	1 387.7
KEROSINE															
Range Oil	80.8	84.4	92.8	111.2	114.2	109.5	104.8	118.1	119.3	142.7	171.2	193.0	174.8	200.8	227.4
Tractor Fuel	11.7	10.8	11.9	12.8	13.2	14.1	16.1	16.8	18.5	20.6	22.5	16.9	15.9	15.1	13.7
Other	56.9	57.0	59.1	60.9	62.6	64.6	64.9	65.7	67.6	78.0	87.7	97.4	91.5	95.9	100.4
All Domestic Uses	149.4	152.2	163.8	184.9	189.0	188.2	185.8	194.6	205.4	241.3	281.4	307.3	282.2	311.8	342.5
Exports	24.3	20.6	22.6	9.8	8.8	7.0	13.0	13.4	16.9	23.7	19.9	9.6	6.9	5.0	3.0
Total Uses	173.7	172.8	186.4	194.1	197.8	195.2	198.8	208.0	222.3	265.0	301.3	316.9	289.1	316.8	345.5

1946-7-8 Military increased to allow for Imports while Miscellaneous, Oil Company and Heating (1948 only) were reduced.
* Forecasts exclude effects of additional natural gas supplies. See schedule for assumed displacement caused by natural gas.

COPPER ALLOY BULLETIN

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Extending Condenser Tube Life By Reducing Fouling

Experience has shown that the life of condenser and heat exchanger tubing is often shortened because of localized attack brought about by foreign matter lodging within the tubes or deposited on the surface of the tube sheet or the tubes themselves.

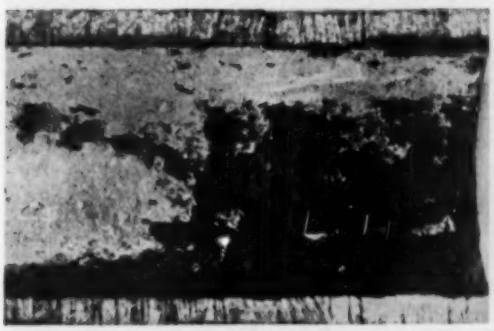
Much can be done, as a preventive measure, by using screens and strainers to keep foreign matter from condensers, heat exchangers and pumps but naturally screens have limitations. They cannot keep out marine growth and slime both of which may seriously injure condenser tubes. Also they cannot prevent corrosion-erosion of tubes when fine particles of sand are suspended in the water.

Operating Conditions Variable

The kinds of materials removed from the cooling water varies surprisingly from plant to plant even though separated by only a few miles. In some plants large rotating screens are in almost continuous operation. Other plants operate their rotating screens intermittently depending on seasonal runs of fish, leaves, branches, etc., brought in during and following periods of storm, high or flood water.

The kinds of debris which have been removed by screens, bars and strainers make an impressive list: fish, seaweed, grasses, leaves, branches of trees, shellfish, paper, nuts, bark of trees, stones, jelly-fish and all sorts of animal and vegetable matter.

The illustration shows impingement corrosion pitting that developed on the inside surface of an Admiralty tube. An object lodged in one side of the tube had caused turbulence. The full force of the circulating sea water was centered on this area while the opposite side was untouched because it was covered by the obstruction. Also other sections showed no appreciable deterioration. Some of the pits were so deep, however, that penetration of the tube wall had occurred in places.



Admiralty condenser tube attacked by impingement corrosion on the inside wall opposite an obstruction. The dark portion is the pitted area, the gray is a thin layer of protective film.

Alloys are available which are much more resistant than Admiralty to this type of attack—Aluminum Brass, Duronze IV (Arsenical Aluminum Bronze) and Cupro Nickel alloys. The individual merits of these alloys vary with the composition of the water.

Experimental work is in progress to ascertain the effect of high water velocities on these alloys. For low velocities in clean sea water impingement corrosion resistance of 70-30 Cupro Nickel containing ½% Iron is outstanding. Nevertheless, no alloy is invulnerable under adverse operating conditions.

Dangers From Foreign Matter

Some of the adverse effects are:

1. Blockage of condenser tubes by debris with marked reduction in heat transfer.
2. Under severe fouling conditions the unit may go "non-condensing" with loosening and leaking of condenser tubes in the tube sheets and warping of the tubes and tube sheets.
3. High back pressure due to restriction of flow by large masses of marine growth and debris damages pumps and associated piping.
4. Debris jamming of valves and/or restriction of flow through valves.
5. Inlet corrosion due to increased water velocity around the object lodged at the inlet. The amount of turbulence due to increased water velocity in the ends of open tubes also increases inlet end corrosion (impingement corrosion or erosion-corrosion) in these tubes.
6. Corrosion pitting or cracking initiated by decaying organisms and vegetation, particularly during periods of shutdown.

Maintenance Vital

Obviously the proper maintenance of screens, bars and strainers and periodic cleaning of condensers and heat exchangers are of the utmost importance to prevent fouling and excessive corrosion. The failure to do this is probably the greatest single cause of trouble in condensers and heat exchangers.

The time and expense involved in keeping screens, bars and strainers clean and in good operating condition may seem excessive yet all concerned with this matter are familiar with the kinds of trouble which have been prevented through the use of properly operating equipment.

Installations along the sea coasts require much ingenuity in the design of rotating screens and care in the selection of materials of construction in order to keep operating difficulties due to wear and salt water corrosion at a minimum. Due to the difficulty in anticipating the load of debris which may be encountered, it is hard to estimate the capacity of such equipment. The size of openings in screens should be small enough to stop all debris which cannot pass through the condenser tubes.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • *ESTABLISHED 1865*

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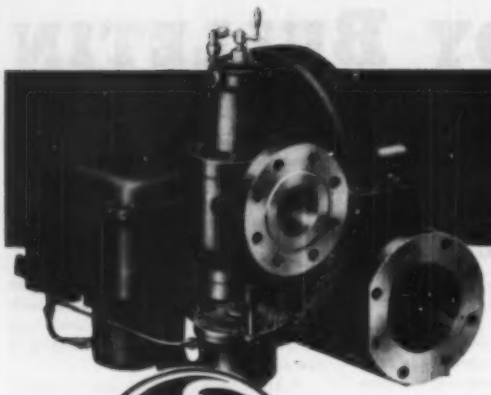


SAVE

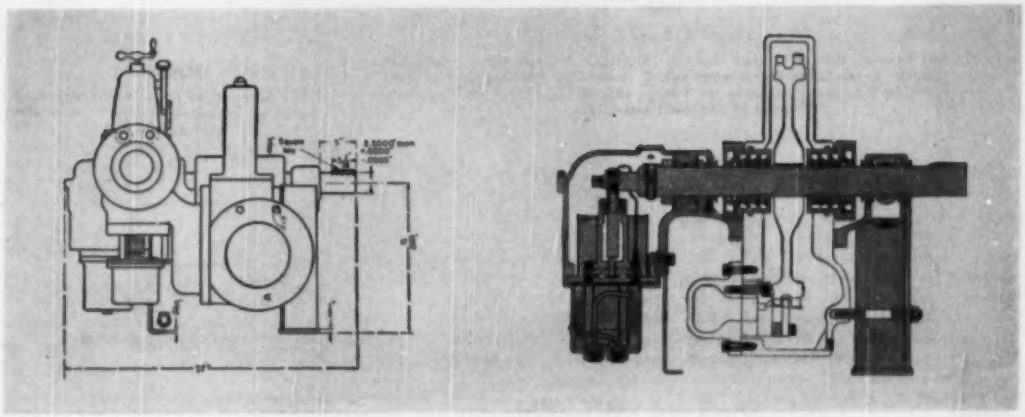
TYPE **DP**

General Electric's DP turbines, available in three frame sizes and a variety of ratings, can be profitably used in many different applications, yet they compose a standard line and incorporate standard parts. This standardization gives you four important benefits:

1 EASY TO STOCK SPARES Because most parts are interchangeable on all models, spares can be stocked at low cost. A spare parts kit, containing 91 items, can be obtained with the turbine. This simple method of stocking spares lowers maintenance costs and provides protection for several DP's in your plant.

FOUR WAYS

WITH Standard Turbines



2 INSTALLATION SIMPLIFIED

All models, regardless of frame size, horsepower, or speed ratings, have identical shaft height, keyways, and coupling fits. Thus, installation problems are simplified, and you can move these center-line supported units from job to job without a "custom line-up."

3 GREATER FLEXIBILITY

As the shaded parts in the diagram illustrate, most DP parts are identical on all frame sizes and ratings. In this way, you can adapt a DP for different job requirements with only minor changes. A different nozzle plate gives you a different horsepower output. A change in governor gears provides a new speed range. When modernization programs demand a change in plant operation, the DP's flexibility will save you money.

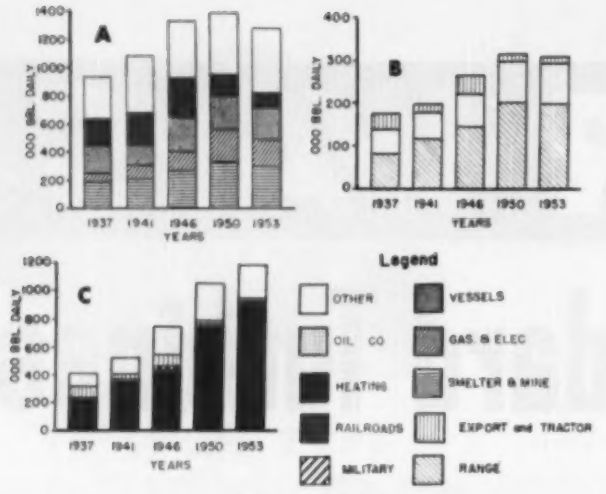
4 A BETTER TURBINE

Manufacturing savings from standardization are passed on to you in the form of special features at no extra cost. For instance: hydraulic governing, combined trip-throttle valve, 30% speed range are advantages you'd expect to find only in custom equipment.

Ask your General Electric representative for full details about the DP mechanical-drive turbine or write for bulletin GEA-4955. Get the full details on how standardization will benefit your plant operation. Apparatus Department, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

252-45



Graphs A, B and C

A (upper left) Principal Uses of Residual Fuel Oil, Total U. S. B (upper right) Principal Uses of Kerosine, Total U. S. (excluding No. 1 range oil), C (lower left) Principal Uses of Diesel and Distillate Fuel Oils, Total U. S. (excluding No. 1 range oil). NOTE—1953 in each case allows for effect of additional natural gas.

losses can be seen at a glance.

It may be interesting to note that since before the war the consumption of kerosine and light fuel oils increased rapidly until this last year. Using the estimate for 1950 given in this report, kerosine will show an increase of 60 percent over 1941 and diesel and distillate oils will show an increase of 100 percent. This compares with an increase for gasoline of about 42 percent and for residual fuel oils of only 28 percent. During 1949, however, kerosine and distillate fuel oils showed up poorly, even after adjusting the figures to take into consideration the unusually warm weather for 1949. Gasoline continued to increase about the way it was estimated and residual fuel oils seemed to have just about kept even with 1948. These changing trends have been hard to evaluate and even more difficult to forecast. Bear this in mind when you judge these forecasts at some later date.

Effect of Natural Gas—Additional Supply

All the known additional major natural gas pipe lines have been catalogued on schedules which show the areas affected and the petroleum liquid equivalents of the additional gas supplies. We think these are pretty complete. The lines are those approved and those projected.

From these data we find that natural gas equivalent to 518,000 barrels a day will be available in 1953 which was not available in 1950. If all of this were to replace oil, the results would be terrific.

Market researchers have been studying the probable effect on our liquid petroleum sales resulting from these additional supplies of natural gas. Their results, with some modifications, are shown on Schedule 1. Here we see the class of user they think will turn to gas, and by areas, and the extent of displacement of liquid fuels. It is interesting to note from this table that on an overall basis for the U. S., we indicate that of the equivalent of 518,000 barrels daily of natural gas available in 1953 not available in 1950, just about one-half of this will displace liquid petroleum. There is included a small quantity of displacement which probably may come about by additional uses of liquefied petroleum gas, particularly in the kerosine category.

Now apply these quantities to the forecasts made for 1953, which were before allowance for additional natural gas supplies. These results with comparisons with 1950 are shown on Schedule 3. The conclusions are rather startling.

Between 1950 and 1953, we believe that the consumption of fuels in District 1 will increase only 5 percent during this entire three year period. As noted in Tables 1 and 2, the distillate fuel oils are expected to increase substantially more than this, but we estimate that the use of residual fuel oil will actually decline. This is primarily due to the loss of heavy gas enrichment oils. In the central part of the U. S. and the Rocky Mountains (Districts 2 and 4) we believe that there will be no additional fuel oils required in 1953 as compared with 1950. Although here again the light fuel oils show a fairly good increase, we look for a substantial decrease in residual and kerosine oils. Part of this decrease in kerosine may come about through the impact of liquefied petroleum gas rather than additional natural gas, but we have considered both of these effects on kerosine in this particular area and that accounts for the somewhat higher percentage decrease which we have shown. In the western area (District 5) we anticipate that there will be an actual loss in fuels sold in 1953 as compared with 1950 to the exent of 8 percent, and unlike the other districts, we think that each of the fuels will show a part of this decline. For the U. S. as a whole the additional natural gas which we think will be utilized and which will displace oil will have the effect of practically cancelling out any increase during these three years for the consumption of liquid fuels. The distillate and diesel oils are expected to show a fairly good increase which would

SCHEDULE 1

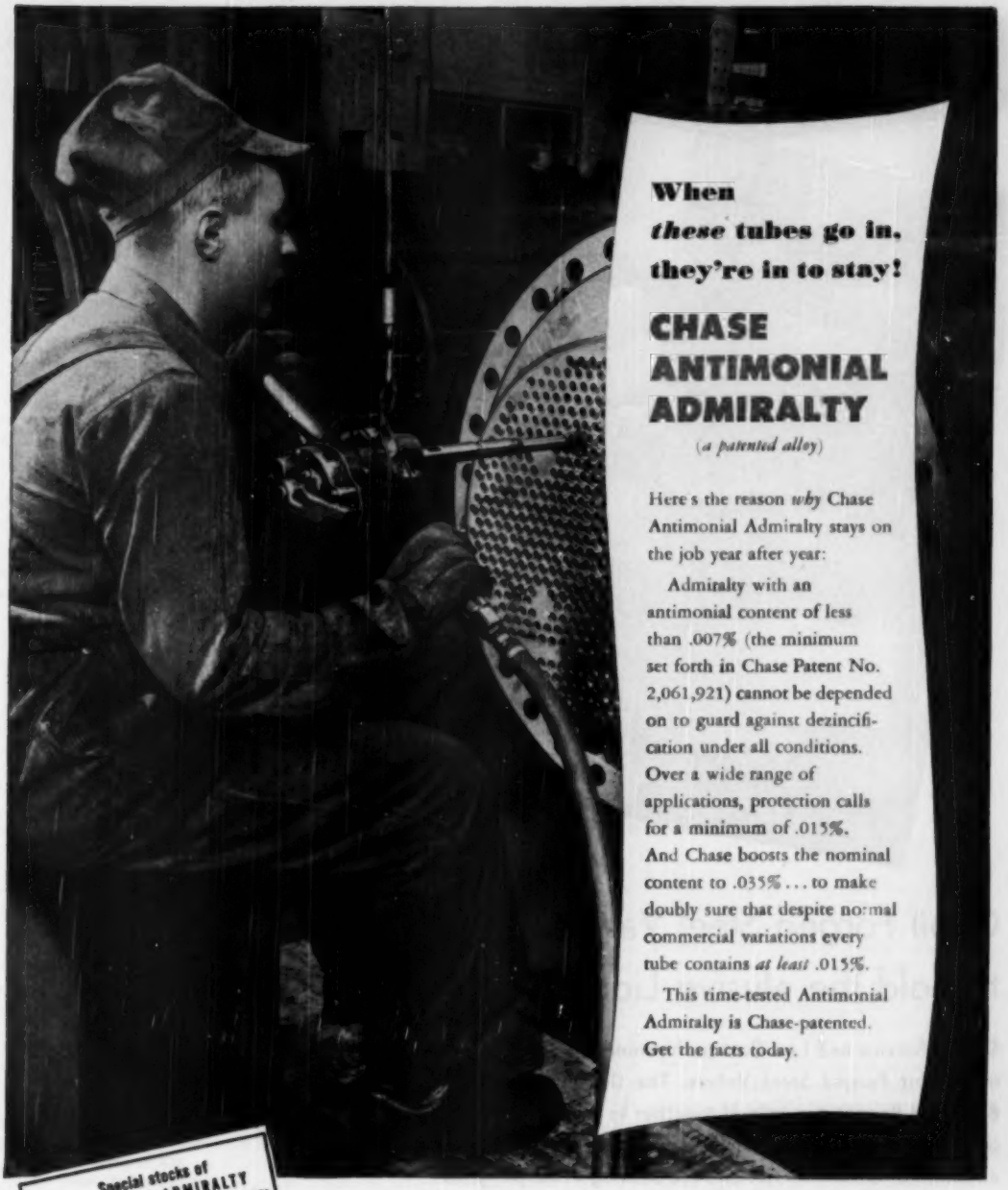
1953 Forecast of Uses Which May Be Reduced by Increased Supply of Natural Gas
(1000 Barrels Daily)

	District 1	Districts 2 and 4	District 5	Total 3 Districts
Distillate Fuel Oil				
Gas and Electric				
Diesel	6.8	12.7	1.2	20.7
Other	15.4	3.5	0.2	21.1
Smelters, Mines and Mfg.—Other	23.0	17.8	1.1	41.9
Heating	471.2	236.0	61.1	768.3
No. 1 Range Oil	9.0	27.4	.....	37.0
Total Dist. Fuel Oil	526.0	289.4	63.6	879.0
Residual Fuel Oil				
Gas and Electric	192.3	9.0	59.2	260.5
Smelters, Mines & Mfg.	171.8	104.1	47.4	323.3
Heating	142.5	32.9	26.0	201.4
Total Residual	506.6	146.0	132.6	875.2
Kerosene				
Range Oil	169.3	41.9	2.2	213.4
Other	31.8	40.3	8.8	80.9
Total Kerosene	201.1	82.2	11.0	294.3
Grand Total Products	1233.7	517.6	207.2	1955.5

Reduced Consumption After Allowing for Increased Gas Use—Estimated

Distillate Fuel Oil				
Gas and Electric				
Diesel	8.5	11.1	1.1	17.7
Other	.....	2.5	0.2	2.7
Smelters, Mines and Mfg.—Other	20.1	12.9	1.0	34.0
Heating	448.5	188.1	48.3	678.9
No. 1 Range Oil	8.6	19.1	.....	27.7
Total Distillate Fuel Oil	479.7	233.7	47.6	761.0
Residual Fuel Oil				
Gas and Electric	147.3	7.6	37.1	191.8
Smelters, Mines and Mfg.	161.8	90.6	38.4	290.8
Heating	134.7	32.9	25.2	192.8
Total Residual	443.8	130.9	100.7	675.4
Kerosene				
Range Oil	159.3	34.7	1.2	185.2
Other	30.9	34.6	7.3	72.8
Total Kerosene	190.2	69.3	8.5	258.0
Grand Total Products	1113.7	433.9	156.8	1694.4
Total Loss from Added Gas	120.0	93.7	50.4	264.1
Fuel Oil Equiv. of New Natural Gas	204	213	101	518

Note: No additional effect on District 3 was assumed.



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(a patented alloy)

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ORBIT VALVE COMPANY

P. O. Box 699 **TULSA, OKLAHOMA**

SCHEDULE 2

All Fuels—Changes in Consumption 1953 vs. 1950 Domestic Plus Export Demand

(1000 Barrels Daily)

	District 1	Districts 2 and 4	District 5	Total U.S.
1950 Estimated				
Distillates	517	330	125	1,045
Residuals	628	249	305	1,386
Kerosene	184	84	11	317
Total	1,329	672	441	2,748
1953 Before Effect of Additional Natural Gas				
Distillates	649	430	139	1,296
Residuals	661	256	306	1,348
Kerosene	205	90	12	346
Total	1,515	768	457	3,030
1953 After Effect of Additional Natural Gas				
Distillates	603	394	122	1,178
Residuals	598	221	278	1,278
Kerosene	194	67	9	309
Total	1,395	672	406	2,765
Percent Change 1953 After Gas Vs. 1950				
Distillates	+17%	+13%	− 2%	+13%
Residuals	− 5	−11	−10	− 8
Kerosene	+ 6	−20	−17	− 2
Total	+ 5%	.....	− 8%	+ 1%

Note: No additional effort on District 3 was assumed.

be offset by losses in residual fuels and kerosine.

Conclusion

Our conclusion is that we find that the probable sales of liquid petroleum fuels in 1953 may be only 1 percent above 1950. How they will trend beyond that time will depend largely upon further developments of natural gas. We have no idea now whether the tremendous strides which have been taking place in the natural gas business will continue beyond 1953 at anywhere near this same rate or not. Our schedules show the additional natural gas, expressed in liquid petroleum equivalents, for 1951 as 283,000 barrels daily, for 1952 this figure drops to 166,000 barrels daily and for 1953 to only 69,000 barrels daily. In other words, the biggest impact we believe will be felt during next year and additions therafter will be much smaller. This conclusion is based upon only the present plans for pipe lines. If some important new pipe lines are approved as we go along, this picture might change considerably and the effects on the consumption of liquid petroleum would be to lower our forecasts. We do not imagine that plans for additional pipe lines will stop by any means, but they may slow up. However, they could very well affect the latter part of this three year period and extend into the more distant future. We believe the industry should watch these developments with increasing concern and try more seriously to evaluate their effect on the liquid petroleum business.

The effects of these developments are far reaching. We have calculated that by 1953 the gasoline yield would have to increase to a new all-time high of over 46 percent out of the crude barrel, whereas the combined fuels we believe would drop from the 44½ percent, which we estimate as required for 1950, to below 42 percent for 1953. An even greater drop of yields is indicated for residual fuel oil. This is predicated upon the imports of residual fuel oil remaining about constant. If the imports decreased, this would naturally throw some additional consumption to the domestic refiner, but if the imports stay at about the same as they are now during the next few years, then the domestic refiner would have to gauge his operations so as to make about 3 percent less residual fuel oil out of the barrel than we anticipate he will make during 1950. These calculations have important implications for the U. S. refiners. They simply say that the trend toward reduced residual yield should be hastened, that we have probably passed the high point for the yield of kerosine, but we would have to get set for new all-time high yields for distillate fuel oils, particularly diesels, and gasoline. With the increased octane requirements for gasoline, this latter may pose a few problems. If our figures are correct, the trend is clearly indicated although the exact percentage yields might be somewhat different when we actually come around to 1953.

Regardless of this somewhat dismal outlook for liquid fuels, the total domestic consumption plus exports of all petroleum products should continue to increase, but rather slowly for the next few years. Those companies which will have significant natural gas sales relative to their oil business will benefit from those sales and tend to offset some of the adverse effects to their oil business.

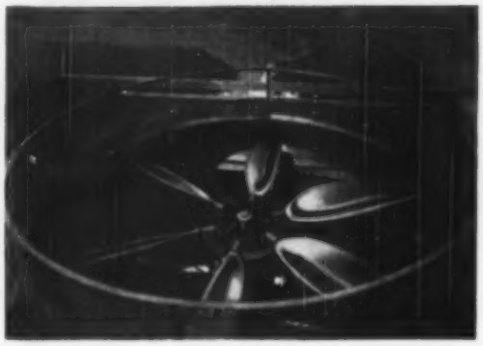
While some better appreciation of the industry problems may result from this paper, we all should appreciate the fact that these are all guesses, that large price changes could affect the forecasts materially, and that a war would so change conditions that our problems then would be how to obtain maximum quantities of almost any kind of petroleum or gas.

SAFETY IN DRIVING—A new "traveling" course instituted by Humble Oil & Refining Company and Humble Pipe Line Company in conjunction with the safety department brings to remote field locations instruction for employes driving company vehicles. The complete course is given in a mobile driver education unit, the large trailer of which, shown above, is divided into two compartments—a testing room and an interview room. Approximately 40 drivers a week are given instruction with aims of driving evaluation and improvement. Five semi-permanent units, staffed by 26 instructors from various departments of company operations, provide a similar program for employes in Houston, Baytown, San Antonio, and at Waco and Irving products terminals.

Consisting of three phases, the course includes an examination of driver's visual skills and reaction time. Testing devices determine field of vision, depth perception, glare recovery, color perception, and steadiness. A written examination quizzes the subject on traffic laws, safe driving practices, and mechanical phases of vehicle operations. The third phase includes an obstacle course for determining driving skill evaluation.

At the end of the course, individual outcome is reviewed privately by instructor and driver at which time shortcomings are noted and improvements suggested.

Why are Oil Refiners standardizing On Hartzite Cooling Tower Fans?



This is significant: Since 1941, thousands of Hartzite plastic fans of 10′ to 22′ diameter have been installed in oil refineries, and *not one* has failed for any cause except obvious abuse.

No wonder oil refiners are standardizing on the Hartzell cooling tower fan!

The Hartzite blade is not only extremely resistant to vibration and shock damage, but also practically impervious to weathering and the acids and alkalies found in oil refining. It stands up unusually well against abrasion.

Where the Hartzell cooling tower fan has been tried it has been specified regularly on following towers by the same user. Practically all the reliable cooling tower builders specify it, many of them exclusively.

This fan solves one of the most irritating and costly problems of the industry. We invite *you* to clip and mail the coupon below for full information, or drop us a line. And remember — new tower or replacement, *insist on Hartzell* fans, 3′ to 22′ diameter.

CLIP! and mail now

SEND Hartzell Cooling Tower Fan information to me.

Name_____

Company_____

Street & No._____

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PROPELLER FAN CO.

DIV. OF CASTLE HILLS CORP.

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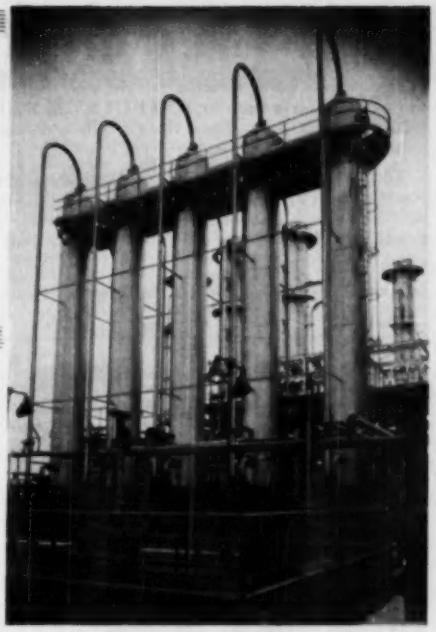
PROPELLER-TYPE FANS AND BLOWERS—ROOF VENTILATORS—UNIT HEATERS • ENGINEERING OFFICES IN PRINCIPAL CITIES

Refinery and Other PLANT CONSTRUCTION

(Tabulation Starts on Next Page)



KATY-3 CONSTRUCTION—Above is a photo taken at Katy-3, a new natural gas processing plant, designed for high recovery of propane at the Katy, Texas, gas cycling plant, Humble Oil & Refining Company, operator. Now on stream, the plant is designed to process 300 million cubic feet of gas daily. Shown are the high-pressure absorbers in the new plant which operate at 1850 pounds. Pumps supply these absorbers and reabsorbers with 4600 gpm. of 37.1° API gravity absorption oil. Two additional absorbers remain to be installed on the left end of the row. See pages 109-110 for further photos and description of this plant.

Vacuum Oil Plans New English Lube Refinery

Vacuum Oil Company, Ltd., a subsidiary of Socony-Vacuum Oil Company, Ltd., is planning a 20,000-barrel-per-day refinery specializing in high grade lubricating oils at Coryton, England. Expected to go on stream in about 30 months, the plant will cost an estimated $30 million and will treat Middle East crude primarily. Products will replace those at present imported from dollar sources, according to the company.

Refinery operations and Vacuum Oil's present marketing facilities in the United Kingdom will be merged with the oil storage, blending and packing business of Croy Bros. & Company, wholly owned subsidiary of Powell Duffryn Ltd. Combined business will be carried on by Vacuum Oil with Socony-Vacuum and Powell Duffryn each having an equal interest in the company.

Natural Gaso Plant At McAllen Completed

With daily capacity increased from 13 million to 20,000 mcf., Continental Oil Company's operated Rincon natural gasoline plant near McAllen, Texas, has been completed at an expenditure of $1.3 million. Located 45 miles northwest of McAllen and 20 miles northeast of Rio Grande City, the plant will have a daily production capacity of approximately 16,000 gallons of liquid petroleum gas and approximately 25,000 gallons of gasoline. It will return approximately 8500 mcf. of gas to the five main reservoirs daily. Remaining gas available will be sold to Border Pipe Line Company for commercial and domestic distribution.

Originally a gas compressor unit, the installation was developed into a natural gasoline plant in 1945. The plant now serves the Rincon Field, which includes more than 150 oil wells and several gas and in-put wells.

Shamrock Cat Cracker

Shamrock Oil & Gas Corporation will install a Houdriflow cat cracking unit at its McKee refinery near Sunray, Texas, to be completed by early 1951. Construction is by Catalytic Construction Company. When finished the unit will have a design fresh charge capacity of 5900 barrels per day, with additional capacity to permit recycling for increased gasoline output.

Ashland Buys Mid-West's National Refining Firm

Mid-West Refineries, Inc. has announced sale to Ashland Oil & Refining Company, of the inventories, trademarks, and substantially all physical properties of its wholly-owned subsidiary, National Refining Company. Ashland is to assume sales commitments and supply obligations of National Refining. The sale includes the Findlay, Ohio, refinery where operation was recently discontinued. Mid-West is also planning to install new processing equipment at its Alma, Mich., refinery for the production of high-octane gasoline and other petroleum products.

Skelly Plans New Facilities

Completion during the year of Skelly Oil Company's fluid cat cracker at the El Dorado, Ark., refinery marks the first of new facilities to be placed in operation under an enlargement and modernization program begun in 1948. Yet to be completed are the new crude distillation unit, expansion of gas recovery, cat polymerization, asphalt manufacturing and gasoline treating facilities, and revamping and modernization of existing thermal cracking units.

Dunkirk Refinery Partly On

The Dunkirk refinery of Societe Generale Des Huiles de Petrole is in partial operation although construction will not be completed until end of 1951. A 6000-barrel-per-day topping unit has been commissioned. Crude oil cargoes have been arriving since December at the refinery whose operations are said to be the first since 1940.

Gaso Extraction Plant For Elk City Field

The adoption of facilities to provide cycling, repressuring, and crude stabilization is included in the design of Shell Oil Company's new Elk City field, Okla., gaso extraction plant. Refinery Maintenance Company was to begin construction immediately. The plant is in Beckham and Washita counties, and when completed, will be capable of handling approximately 100,000 mcf. gas daily.

The cycling, repressuring, and crude stabilization facilities would considerably increase the recovery of valuable products, according to Shell. However, their installation depends on the adoption of some plan to unitize the interest of operators and royalty owners. When such an agreement is attained, other operators in the field would be given the opportunity of sharing in the ownership of the plant.

National Co-Op Modernizes At McPherson Refinery

Capacity at the McPherson, Kan., refinery of National Cooperative Refinery Association will be boosted from the present 18,000 to approximately 22,000 barrels per day with the installation of a "package" fluid cracking and catalytic polymerization. Existing equipment is to be modernized with tankage added and utilities expanded. Engineering work is under way by Refinery Engineering Corporation which will supervise construction under license from Universal Oil Products Company.

National Co-Op also will lay 30 miles of new 8-inch line from Rice County to the plant for additional crude.

REFINERY and Other PLANT CONSTRUCTION

The tabulation appearing below, and on four additional pages, is a regular PETROLEUM REFINER feature which, it has been shown, fills a definite need in the processing industry.

To the end that the tabulation appears correct and complete each month, readers are asked to 1) send in "boxscore" data (as called for by the column headings) on projects not listed; 2) furnish details which are missing in any item in the current tabulation and 3) report from time to time on the progress of these projects.

Such cooperation, of tremendous aid in keeping the tabulation continuously up to date, will be much appreciated.

Address Editor, Petroleum Refiner, Box 2608, Houston 1, Texas.

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
EAST									
Calif. Refg. Co.	Barber, N. J.	Crd. Cat. Crk., Reformer, Alkylation	25,000 bbls. 10,000 bbls. 5,000 bbls.		Under Constr.	Jan., 1951	Houdry U.O.P. Kellogg	Houdry, Braun Braun Kellogg	Braun Braun Kellogg
		Crude Units	50,000 bbls.					Braun	Braun
		Boiler Plants	300,000 lbs. hr.					Braun	Braun
E. I. Dupont	Parkersburg, W. Va.	Tetrafluoroethylene Resin Plant			Under Constr.	Summer, 1950			
Esso Standard Oil Co.	Richmond, Va.	Esso Extractive Refining Plt.	3,500 gals.	$70,000	Under Constr.	April 15, 1950		Staff	Howard-Mitchell
Esso Standard Oil	Bayonne, N.J.	Steam Boilers	400,000 lbs. hr		Under Constr.	2nd Qtr., 1950		S.O.D., Day & Zimmerman	S.O.D. & Zimmerman
Freeport Sulphur Co.	Westville, N.J.	Sulfur Recovery	40 tons		Under Constr.	1950			Girdler
Socony-Vacuum Oil Co.	Paulsboro, N.J.	Propane Deasph.	5,940 bbls.		Under Constr.	2nd Qtr., 1950	Juik	Badger	Badger
Socony-Vacuum	Paulsboro, N.J.	MEK Dewaxing	3,300 bbls.		Under Constr.	2nd Qtr., 1950	Texaco	Badger	Badger
Socony-Vacuum	Paulsboro, N.J.	Light Oil Trtng.	28,000 bbls		Designing			Badger	Badger
Socony-Vacuum	Paulsboro, N.J.	Mod. Comp. Plt. Dept.	5,000 bbls.		Under Constr.	2nd Qtr., 1950		Staff	Staff
Socony-Vacuum	Buffalo, N.Y.	Ther. Cat. Crk.	15,000 bbls.			1950			
Socony-Vacuum	Brooklyn, N.Y.	Ther. Cat. Crk.	15,000 bbls.			1950			
L. Sonneborn Sons	Petrolia, Pa.	Antipollution, Acid		$450,000	Under Constr.	2nd Qtr., 1950		Chemico, Knowles	Keen & Wire, Chemico
Standard Oil Co. (California)	Mobile, Ala.	Ref. Conversion, Enlargement			Under Constr.	April, 1950			
United Refining Co.	Warren, Pa.	Lab. Steam Gen.	60,000 lbs. hr.			4th Qtr., 1950			Union Iron Wks.
MID-CONTINENT									
*Ashland Oil & Refg. Co.	Canton, Ohio	Change to Poly, Light Ends Plts.	6125 bbls.	$40,000	Under Constr.	April, 1950	U.O.P.	Staff	Cat. Constr.
Cities, Service, Del.	Cicero, Ill.	Compound Plt.	1,200 bbls.	$4 million	Contracted	July, 1950			Sollitt
Consolidated Gas Utilities Corp.	Cement, Okla.	Compr. Sta.	40,000 mcf		Under Constr.	2nd Qtr., 1950		Dresser	Dresser U.O.P., Brown & Lite
Deep Rock Oil Corp.	Cushing, Okla.	Cat. Cracker	5,000 bbls.		Under Constr.	Spring, 1950		U.O.P.	J. & L. Constr.
The Derby Oil Co.	Wichita, Kans.	Cat. Crk. Change			Planning				
Dewese Oil Co.	Weston, Ohio	Lube Filtering	250 bbls.	$15,000	Under Constr.	Spring, 1950		Staff	Staff
The Dow Chem Co.	Midland, Mich.	Comp. Sta. & Pipeline	5,000 mcf gas	$1.5 million	Completed			Staff	Prichard, Mahoney
Indiana Farm Bureau Cooperative Assn.	Mt. Vernon, Ind.	Fluid Cat. Cr.	4,000 bbls.		Under Constr.	1951		U.O.P.	Staff
Indiana Farm Bureau	Mt. Vernon, Ind.	Gas Concen.	3,500 bbls.		Under Constr.	1951			U.O.P.
Indiana Farm Bureau	Mt. Vernon, Ind.	Vacuum Unit	800 bbls.		Under Constr.	1951			U.O.P.
Magnolia Pet.	Chitwood, Okla.	Compr. Plt.	24,750 mcf		Under Constr.	May, 1950		Staff, Constr. Service	Delta Constr. Service
*Midland Co-Op. Wholesale	McPherson, Kans.	Expansion	122,000 bbls.	$4 mln.	Planned				
Mississippi River Fuel Co.	Star City, Ark.	Comp. Sta.	5,000 hp.		Under Constr.	Spring, 1950		Ref. Maint.	Ref. Maint.
Mississippi River	Pocahontas, Ark.	Comp. Sta.	5,000 hp.		Under Constr.	Spring, 1950		Ref. Maint.	Ref. Maint.
Mississippi River	Fredericktown, Ark.	Comp. Sta.	4,000 hp.		Under Constr.	2nd Qtr., 1950		Ref. Maint.	Ref. Maint.
National Co-Op. Refinery Assn.	McPherson, Kans.	Polymerization, Fluid Cat. Crk., Add Tankage, Utilities	22,000 bbls.	$2 mln	Under Constr.		U.O.P.	Ref. Eng.	Ref. Eng.
Northern Nat. Gas	Sublette, Kans.	Gasoline Plant	295,000 mcf		Under Constr.	May, 1950			Pritchard
The Ohio Oil Co.	Lima, Ohio	Ref. Prdts Term.	200,000 gals.		Under Constr.	June, 1950			Poling & Bacon
Oklahoma Refg. Co.	Seminole, Okla.	Refinery	200 bbls	$40,000					
Pan-Am Southern Corp.	El Dorado, Ark.	Delayed Coke Water Cooling Tower, Steam Gen. Boiler, Coke & Loading	9,300 bbls.		Planning	Oct., 1950		Lummus	Lummus
Petco Corp.	Blue Island, Ill.	Houdry, Cat. Crk., LPG Recov.	5,000 bbls.	$400,000	Under Constr.	Mid., 1950	Houdry	Houdry	Clarke, Cat. Constr.
Petroleum Specialties, Inc.	Flat Rock, Mich.	Cat. Cracker	3,000 bbls.	$2 million	Planning				
Phillips Petroleum	Okmulgee, Okla	Cat. Poly Unit			Under Constr.	May, 1950		Staff	Staff
Phillips Pet., et al	Edmond, Okla.	Add Nat. Gaso Plant	60,000 mcf		Under Constr.	April, 1950			Ref. Maint.
The Shallow Water Refining Co.	Shallow Water, Kansas	Reforming Unit	1,250 bbls.	$85,000	Under Constr.	April, 1950	Perco	Koch Eng.	Koch Eng.
Shell Oil Co.	Elk City, field Okla.	Gas Extract. Plt.	100,000 mcf gas		Under Constr.				Ref. Maint.
Shelly Oil Co.	El Dorado, Kans	Crd. Dist. Cat. Crk.	35,000 bbls.	$8-10 million	Under Constr.	April, 1950			
Socony-Vacuum Oil Co.	E. St. Louis, Ill.	Thermal Crack.	13,200 bbls.		Under Constr.	2nd Qtr., 1950		Staff	Bechtel
Socony-Vacuum	E. St. Louis, Ill.	Miscel Ref. Addn.			Under Constr.	2nd Qtr., 1950		Staff, Bechtel	Bechtel
Socony-Vacuum	Augusta, Kans.	Houdry Conversion to T.C.C.	15,000 bbls.		Planned	End 1950	Socony-Vacuum		
Socony-Vacuum	Trenton, Mich.	Houdry Conversion to T.C.C.	15,000 bbls.		Contracted	End 1950	Socony-Vacuum		Braun
Standard Oil Co., (Ohio)	Cleveland, Ohio	Houdry Cat. Change		$375,000	Completed				Cat. Constr.
Standard (Ohio)	Cleveland, Ohio	Houdry to TCC	18,000 bbls.	$4 million	Under Constr.	Nov., 1951	Socony-Vac.	Bechtel	Bechtel
Standard (Ohio)	Lima, Ohio	Clay Contact	2,400 bbls.	$1 million	Under Constr.	Mid., 1950		Lummus	Lummus
Standard (Ohio)	Lima, Ohio	Inc. Tank. Cap.	215,000 bbls.	$240,000	Under Constr.	Early 1950		Staff	Hammond
Standard (Ohio)	Lima, Ohio	Liquid Gas Plt.	2,000 bbls.	$220,000	Completed			Staff	Undetermined

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◀ *Orifice Plate.*

Taylor Pitot-Venturi ▶

Taylor Pre-Calibrated Orifice Element ▼

(1) Thin and thick type Orifice Plates from 2 to 24" in all standard materials. (2) Pre-Calibrated Orifice Assembly for high-accuracy with pipe sizes less than 2" are a "Specialty of the House" with Taylor. (3) The new and exclusive Taylor Pitot-Venturi Flow Element which produces greater differential with practically no pressure loss—7 to 10 times greater than by the conventional Pitot Tube. (4) Also standard Venturi Tubes. (5) Flow Nozzles from 3 to 14" in all standard materials.

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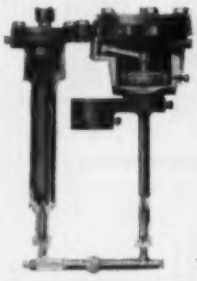

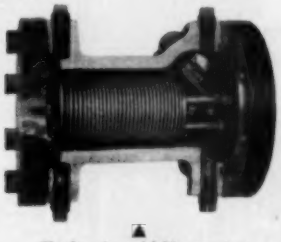

▲ *Taylor Aneroid Manometer*

◀ *New Taylor Mercury Manometer*

(1) New Taylor high-accuracy Mercury Manometer which features Teflon bearings, high energy output, submerged check valves, ½ of 1% accuracy, an adjustable leakless damping unit, and interchangeable range tubes for continuous ranges from 10 to 533 inches of water. (2) Taylor Aneroid (Mercury-less) Manometer, available in All-316 Stainless Steel or Cast Steel, accurately measures flow of hard-to-handle corrosive materials. No mercury to replace, no stuffing box. Sealing fluids or blow-back systems seldom needed. Long service. Easy cleaning. Easy range changes. Both Manometers available with Square Root Integrators.

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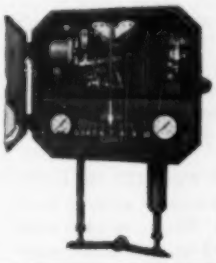
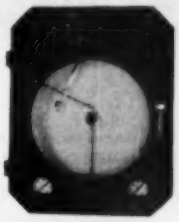




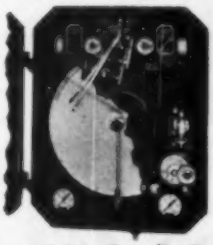
▲ *Fulscope* Recording Receiver Controller*

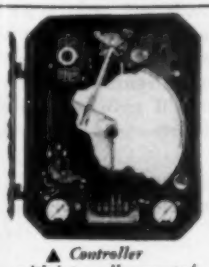
◀ *Taylor Indicating Transmitter*

Taylor Remote Transmission Systems accurately, quickly, economically, and safely transmit rate of flow to conveniently located point. Transmitters can be indicators, recorders or controllers. High accuracy—systems are calibrated to within ½ of 1% accuracy. High speed—only 2-second lag in 300 feet. Gives central control of widely distributed processes at one convenient point. Concentric dial transmitter with Mercury Manometer also available.

*Trade-Mark

• FOR CONTROL





▲ *Controller with internally mounted automatic-manual unit*

▲ *Fulscope Recording Pneumatic-Set Flow Controller*

Indicating or recording controllers in single or double duty form, with adjustable sensitivity or automatic reset. Ratio Flow Controllers with two Manometers attached. Control point may be adjusted by any other process variable. Pneumatic-set controllers whereby control point can be pneumatically adjusted from any remote location. Internally or externally mounted automatic to manual units.

• • •

For complete details, write for new Flow Catalog 98175, or ask your Taylor Field Engineer. He'll show you how Taylor Instrumentation can help you solve *any* flow problem. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

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K&M *"Century"* ASBESTOS CORRUGATED WALLS

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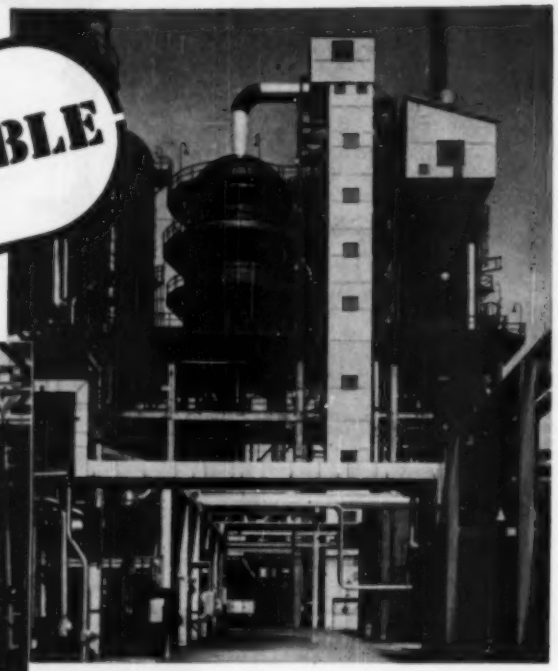

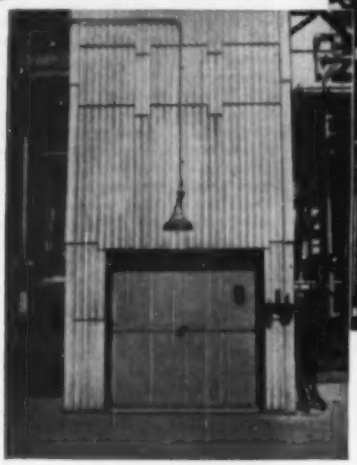

Mid-Continent Petroleum Corporation Refinery, West Tulsa, Oklahoma.

Elevator Tower and Penthouse protected by K&M "Century" Asbestos Corrugated, applied with "TOP-SIDE"* Fasteners.

Industrial and commercial building walls need a rugged constitution. That's exactly why K&M "Century" Asbestos Corrugated walls are bound to be an economy for you. They provide all the structural strength and staying power of the proved K&M Asbestos-Cement combination. They shed extremes of weather and other atmospheric threats, without even needing paint. They defy fire, rust, rot, rodents and termites. You can plainly add it all up to long-term freedom from maintenance.

Initial savings are just as plain, for K&M "Century" Asbestos Corrugated goes up fast, no special work needed. Fitting is easy with ordinary cutting and drilling tools. Even scaffolds and extra labor can be eliminated by using "TOP-SIDE"* fasteners. They're made so that K&M Corrugated can be anchored to steel members of any type, on sides or roofs. You'll have protective enclosure—and cost figures—that keep on looking good.

Write for the name of your nearest K&M Distributor, and full data on K&M "Century" Asbestos Corrugated.

*U. S. Pat. & R. Enterprise Corp.

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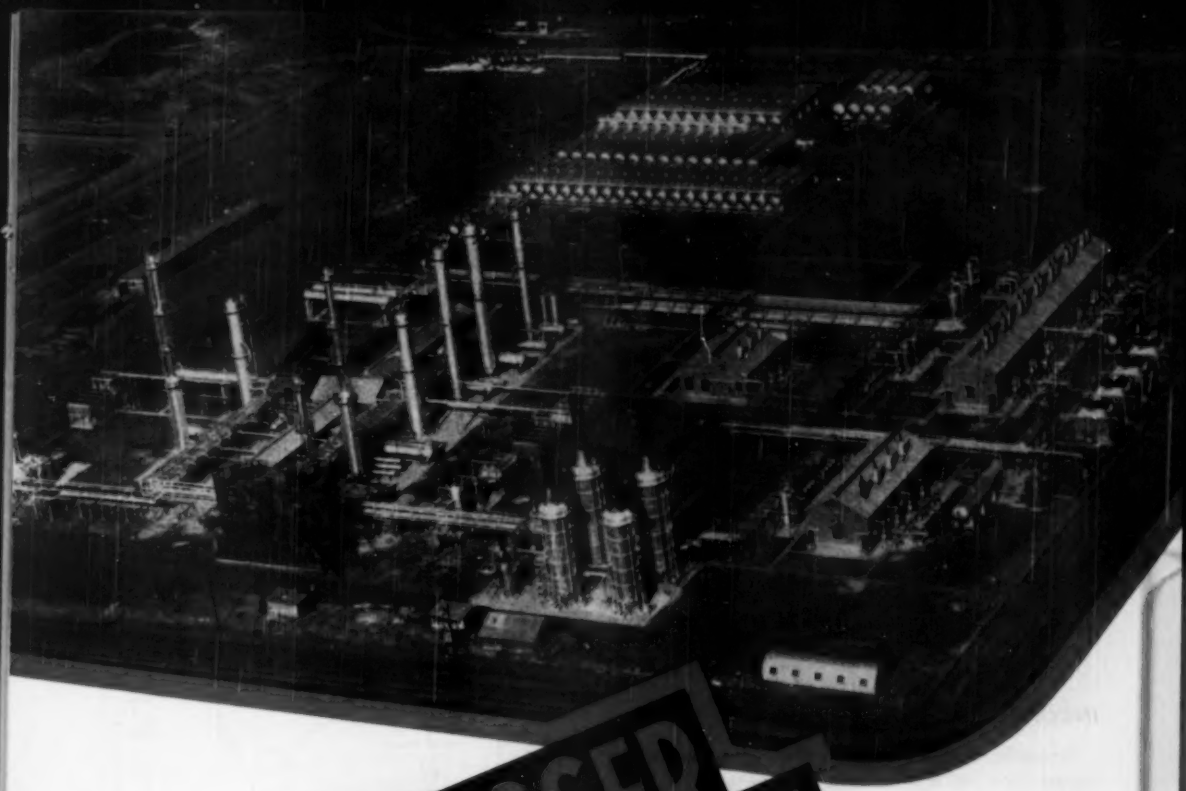
REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Standard (Ohio)	Lima, Ohio	Furfural Unit	4,800 bbls.	$13 million	Under Constr.	Mid 1950	Texaco	Lummus	Lummus
Standard (Ohio)	Lima, Ohio	Crd. Dist. Coke	19,500 bbls.	$5.5 million	Completed		Kellogg	Kellogg	Lummus
Standard (Ohio)	Lima, Ohio	Solvent Dewax.	3,500 bbls.	$4.5 million	Under Constr.	Mid. 1950	Texaco	Lummus	Lummus
Standard (Ohio)	Lima, Ohio	Vacuum Unit	9,000 bbls.	$1 million	Under Constr.	Mid. 1950		Lummus	Lummus
Standard (Ohio)	Lima, Ohio	Propane Deasph.	800 bbls.	$1 million	Under Constr.	Mid. 1950		Kellogg	Kellogg
Standard (Ohio)	Lima, Ohio	Expand Refinery	†20,000 bbls.		Under Constr.	April 1, 1951		Foster Wheeler, Kellogg	Foster Wheeler, Kellogg
The Texas Co.	Lawrenceville, Ill.	Houdriflow Unit	4,800 bbls.		Under Constr.	April, 1950	Houdry		Process Eng.
Tide Water Associated Oil Co.	Drumright, Okla.	Cat. Cracker	80 bbls.	$5 million	Under Constr.	Late April, 1950		Koppers	Koppers
U.S. Dept. of Interior	Louisiana, Mo.	Demonstration oil-from-coal	250 bbls.	$100,000	Completed		U.O.P.	Ref. Eng.	Ref. Eng.
Vickers Petroleum Co., Inc.	Potwin, Kans.	Thermal Poly Unit	1,000 bbls.		Completed				
Vickers Petroleum	Potwin, Kans.	Reforming	6,000 bbls.		Under Constr.	June, 1950			
Vickers Petroleum	Potwin, Kans.	Desalting							
SOUTHWEST									
Ada Oil Co.	Houston, Texas	Loading Sta.			Completed			Bellie	
Alba Refg. Co.	Alba, Texas	Asphalt Refining	2,000 bbls.	$150,000	Under Constr.	Spring, 1950			
Calumet Refg. Co.	Princeton, La.	Blending Oil Tank House	700 bbls.		Under Constr	2nd Qtr., 1950		Staff	Staff
Carthage Hydrocol, Inc.	Brownsville, Texas	Hydrocol	87,000 mcf		Under Constr.	Spring, 1950	Hydro-Ree., Inc. Texaco	McKee, Hydro-Ree., Inc.	McKee
Coastal Refineries, Inc. & Mayfair Minerals, Inc.	McAllen, Texas	Cycling Plant	75,000 mcf		Completed			Gasc. Plant	Gasc. Plant
Continental Oil Co.	McAllen, Texas	Add Gasc. Plt.	30,000 mcf	$1.3 million	Completed				J. & L. Constr.
Continental Assocs.	Near Nordheim, DeWitt County, Texas	Gas Comp.	12,000 mcf	$1 million	Under Constr.	April, 1950	None	Process Eng.	Process Eng.
Del Rey Petroleum Co.	Chesterville, Tex.	Pressure Absorption Plant	25,000 mcf		Under Constr.			O. L. Olsen	Olsen
Dow Chemical Co.	Freeport, Texas	Ammonia Plant	100 tons	$5 million	Planning	Late 1950			Austin
El Paso Natural Gas.	Castro County, Texas	Compressor Sta.	4,050 hp.	$1.1 million	Completed			Staff	Staff
El Paso Natural Gas.	Crane County, Texas	Compressor Sta.	4,400 hp.	$1.27 million	Under Constr.	June, 1950		Staff	Staff
E. I. DuPont de Nemours Co., Inc.	Victoria, Texas	Chemical Intermediate for Nylon			Design	Early 1951		Staff	Staff
Face Standard Oil Co.	Baton Rouge, La.	Main Office, Cafeteria, Crude Desalting Unit			Under Constr.	May, 1950		Brisman & Murell, Staff	Staff, Harris
Fullerton Oil Co.	Snyder, Texas	Refrig. Nat. Gasc. Plt.	40,000 mcf		Contracted	July, 1950			Hudson
Humble O&R.	Baytown, Texas	Rust Replacing of Butyl Bldg.			Under Constr.	May, 1950		Staff	Tellepsen
Humble O&R.	Baytown, Texas	Miscl. Facilities		$1 million	Projected				
Humble O&R.	Jourdanton Field, Texas	Gasoline Plant	20,000 mcf		Under Constr.	July, 1950			Hudson
Humble O&R.	Baytown, Texas	Research Bldg.			Under Constr.	Aug., 1950		Vourhees-Walker Ferguson	Kaetsen Bellows
Humble O&R.	Baytown, Texas	Mech. Maint. Bldg.			Under Constr.	Oct., 1950			
Magnolia Pet. Co.	Beaumont, Tex.	Two Houdry's to T.C.C.	30,000 bbls.		Authorized	Late 1950			Lummus
Magnolia Pet. (Operator) et al.	Lolita-La Ward, Jackson County Texas	Comp. Sta.	15,000 mcf		Under Constr.	April, 1950		West	West
Mathieson Chem. Co.	Pasadena, Texas	Fertilizer Plt.			Under Constr.	1950		Owner	
Mayfair Minerals, Coastal	McAllen, Texas	Cycling Plant	50,000 mcf		Completed			Gasc. Plant	Gasc. Plant
McMurray Refining Co.	Tyler, Texas	Fluid Cat Cracker, Gas-Conc., Feed Prep. & Cycle-Oil Crk.	5,000 bbls.		Planned	Fall, 1950		U.O.P.	U.O.P.
North American Oil Consolidated & Ungren & Frazier.	Bartlett Field, Jones County,	Gasc. Plt., Gas Injection Facilities			Planning				
Pan Am. Ref.	Texas City, Tex.	Desulfo Unit		$25,000	Under Constr.	Spring, 1950		Tellepsen	Tellepsen
Pan Am. Ref.	Texas City, Tex.	Lab., Pilot Plt. Additions			Under Constr.	Spring, 1950		Ferguson	Ferguson
Panhandle Producing & Refining Co.	Wichita Falls, Texas	Cat. Cracker	1,500 bbls.	$1 million	Completed		U.O.P.	U.O.P., J. & L.	J. & L. Constr. U.O.P.
Phillips Chemical	Etter, Texas	Fertilizer Plant	300 tons		Completed		Chemico	Chemico	Brown & Root
Phillips Chemical	Etter, Texas	Inc. Cap. Cactus Ammonia Plt.	440 tons	$5.3 million	Completed		Chemico	Chemico	Brown & Root
Pontiac Refining Co. & Chicago Corp.	Corpus Christi, Texas	Ref. Petro-chem. Plt.	5,000 bbls. gaso., 170,000 bbls. ethylene glycol, 3,000 lbs. ethylene	$15 million	Design, Planning	Mid., 1951			
The Pure Oil Co.	Dollarhide, Andrews Co., Tex	Nat. Gasc. Plt.	22,000 mcf	$6 million	Under Constr.	July, 1950			Hudson
The Shamrock Oil & Gas	Sunray, Texas	Cycloversion Unit	15,000 bbls.	$200,000	Completed		Perco	Staff	Staff
*Shamrock Oil & Gas Co.	Sunray, Texas	Houdri. Cat. Crk.	5,900 bbls.		Under Constr.	Early 1951			Cat. Constr. (Philadelphia)
Shell Oil Co.	Provident City, Texas	Gas Stripping	60,000 mcf	$2.5 mil.	Under Constr.	May		Fluor	Fluor
Socony-Vacuum Oil Co.	Beaumont, Tex.	Thermofor Cat. Cracker	15,000 bbls.			1950			
Standard (Texas)	7 mi N. Snyder, Scurry Co., Texas	Gasc. Absorp. Plt.	30,000 mcf	$2-3 million	Planning	Mid., 1950			
Standind O&G	Brownsville, Tex.	Chemical Plant	150 tons		Under Constr.	April, 1950		Badger Stearns-Roger	Badger Stearns-Roger
Standind O&G	N. Cowden, Tex.	Gasoline Plant	50,000 mcf		Under Constr.	April, 1950			
The Texas Co.	Tijerina-Canales Field, Texas	Gas Compression	3,000 mcf		Under Constr.	July, 1950			
United Gas Pipe Line Co.	Karnes City, Texas	Nat. Gas., Condensate Process	10,000 mcf	$1 million	Under Constr.	April, 1950		Delta	Delta
*United Gas Pipe Line	Sterlington, La.	Dehydration	†25,000 mcf		Under Constr.				Staff
ROCKY MOUNTAIN									
El Paso Nat. Gas Co.	Lea County, N. M.	Compressor Sta.	5,200 hp.	$1.35 million	Completed			Staff	Staff
El Paso Nat. Gas	ditto	Gas Purif. Plt	50,000 mcf	$325,000	Completed			Stearns-Roger	Staff
El Paso Nat. Gas	ditto	Gasc. Absp. Plt.	50,000 mcf	$285,000	Completed			Stearns-Roger	Staff
Empire Pet. Co.	Denver, Colo.	Asphalt Vac.	1,500 bbls.		Completed			Koch	Staff
Frontier Refining Co.	Cheyenne, Wyo.	2 Coke Crks.	2,800 bbls	$725,000	Contracted	June, 1950	U.O.P.	Ref. Eng.	Ref. Eng.
Salt Lake Refining Co.	Salt Lake City	Cat. Cracking	25,000 bbls.	$10 million	Authorized	Jan., 1951	Houdry	Bechtel-Houdry	Bechtel
Sioux Oil Co.	Newcastle, Wyo.	Thermal Crk.	1,200 bbls.	$300,000	Under Constr.	Spring, 1950	U.O.P.	Koch	Staff

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Sioux Oil Co.	Newcastle, Wyo	Cat. Poly.	90 bbls.	$100,000	Under Constr.	Spring, 1950	U.O.P.	Kuhn	Staff
Stanray-Vacuum Oil Co.	Casper, Wyo.	Topp. Revisions	5,000 bbls.	.....	Under Constr.	2nd Qtr., 1950	.....	Staff	Cat. Constr.
WEST COAST									
Continental Oil Co.	Ventura, Calif.	Rev. to Gaso. Fit.	20,000 mcf	.....	Under Constr.	May, 1950	.....	Ref. Maint.	F. & A. Ref.Maint.
Coline Gasoline Co.	Ventura, Calif.	Rev. to Gaso. Fit.	13,000 mcf.	.....	Completed	.....	.....	Ref. Maint.	Ref. Maint.
General Pet. Corp.	Torrance, Calif.	H2S Absorption	55 tons	.....	Completed	.....	.....	Badger	Badger
General Petroleum	Torrance, Calif.	Add Odor Abate. System	.....	$80,000	Under Constr.	May, 1950	.....	Staff	Staff
General Petroleum	Torrance, Calif.	Dust Collecting Sys. to Gaso. Cat. Crk.	.....	$25,000	Under Constr.	May, 1950	.....	Staff, Ref. Maint.	Ref. Maint.
General Petroleum	Torrance, Calif.	Smoke, Fume, Odor Contrls.	.....	$100,000	Under Constr.	.....	.....	Staff	.....
Hancock Chemical Co.	Long Beach, Cal.	H2S Recovery	50 tons	$1 million	Completed	.....	.....	Badger	Badger
Hancock Oil Co.	Long Beach	Ethylene Glycol	60,000 lbs.	.....	Considering	.....	.....	Badger	Badger
Paloma Refining Co.	Paloma Field, Calif.	Ext. Absp. Sect.	60,000 mcf	.....	Under Constr.	June, 1950	.....	.....	.....
*Richfield Oil Corp.	So. Cuyama, Calif.	Absp. & Comp. Fit.	30,000 mcf	.....	Under Constr.	May, 1950	.....	Fluor	Fluor
Richfield Oil Corp.	Cuyama, Calif.	Absorption H2S Removal	15,000 mcf	.....	Completed	.....	.....	Fluor	Fluor
Richfield Oil Corp.	Cuyama, Calif.	Comp. Fit. Exte.	2,040 hp.	.....	Completed	.....	.....	Fluor	Fluor
Rincol Asphalt & Bitumuls Co.	Point Wells, Wash.	Asphalt Refinery	.....	.....	Under Constr.	Mid., 1950	.....	.....	.....
*Standard Oil (Calif.)	Richmond, Calif.	Vac. Tower T.C.C. Conv.	80,000 bbls. 1500 tons/hr.	.....	Planning Under Constr.	Mid., 1951	.....	.....	.....
Union Oil Co. of Calif.	Bren Hinda, Cal.	Research Plant	.....	$5 million	Projected	Sept., 1950	.....	.....	.....
Union Oil of Calif.	Oleum, Calif.	Revise Refg.	.....	$4 million	Under Constr.	Spring, 1950	.....	Parsons, E. & A.	Ref. Maint.
Union Oil of Calif.	Oleum, Calif.	Improve Handling Facilities	.....	$1.5 million	Under Constr.	Spring, 1950	.....	Mathews, Montgomery	Early, C. N. Peterson, Mathews
Union Oil of Calif.	Oleum, Calif.	Tankage and Utilities	.....	$1.5 million	Under Constr.	Spring, 1950	.....	Parsons	Eaton & Smith, C.B.&I., Utah
Union Oil of Calif.	Oleum, Calif.	Add Main Office Shops	.....	$1 million	Under Constr.	Spring, 1950	.....	Austin, Field & Fry, D. R. Warren Co., Montgomery	E. S. McKittrick, Parker, Steffens & Pearce
Union Oil Co.	Oleum, Calif.	Add Ref. Facils.	.....	.....	Under Constr.	Spring, 1950	.....	.....	.....
FOREIGN									
Canada									
British-American Oil Co.	Edmonton, Alberta	Refinery	6,000 bbls.	.....	Contracted	Early, 1951	.....	Can. Kellogg	Can. Kellogg
British-American Oil	Clarkson, Ontario, Can.	Propane Desphalt.	700 bbls.	$400,000	Under Constr.	Mid., 1950	S.O.D., Union Oil (Calif.), Standard(Ind.)	Canadian Kellogg	Canadian Kellogg
Excelsior Refs., Ltd.	Lloydminster, Alberta	Cap. Increase	3,000 bbls.	.....	Under Constr.	1950	.....	.....	.....
Excelsior Refs., Ltd.	Lloydminster	Capacity Inc.	1,500 bbls.	.....	Design	1950	.....	.....	.....
Imperial Oil, Ltd.	Leduc Field	Gas Absorption	24,000 mcf	$6.5 million	Under Constr.	Mid. 1950	.....	Braun	Braun
Imperial Oil	Winnipeg	New Refinery	10,000 bbls.	$10 million	Planning	May, 1951	.....	Canadian Kellogg	Canadian Kellogg
Panther Oil and Grease Co.	Leaside, Toronto, Ontario	Grease and Compounding	.....	.....	Projected	.....	.....	.....	.....
Shell Oil Co. of Canada, Ltd.	Montreal East, Quebec	Fluid Cat. Crk., Vac. Flash Gas Recov., Poly, Treat	35,000 bbls.	.....	Under Constr.	Late 1950	.....	Staff	Fluor, Ltd., McKee
Supreme Refineries, Ltd.	Hanna, Alt.	Nat. Gaso. Fit.	1,000 mcf.	$100,000	Contracted	June, 1950	.....	Staff	Staff
Supreme Refineries	Ogden, Alt.	Refinery	1,000 bbls.	$300,000	Under Constr.	June, 1950	.....	Staff	Staff
Latin America									
Administracion Nacional Combustibls Alcohol y Portland	Montevideo, Uruguay	Lube, Asphalt Units	7,500 bbls.	.....	Under Constr.	1st Qtr., 1950	.....	Foster Wheeler	Foster Wheeler
Conselho Nacional do Petroleo	Mataripe, Bahia, Brazil	Thermal Cracking Refinery	2,500 bbls.	$5 million	Under Constr.	Dec., 1950	.....	Kellogg	Kellogg, Staff
Conselho Nacional de Petroleo	Cubatao Sao Paulo, Brazil	Therm. Crk. Ref.	45,000 bbls.	.....	Designing	.....	.....	Hydrocarbon	Fives-Lille & Schneider, Staff
Conselho Nacional do Petroleo	Mataripe, Bahia, Brazil	Ref. Expn	2,500 bbls.	$3.5 million	Planning	Dec., 1950	.....	.....	.....
Creole Pet. Corp.	Amuay Bay, Venezuela	Refinery	60,000 bbls.	$150 million	Completed	.....	.....	S.O.D.	Foster Wheeler J. G. White
Creole Pet. Corp.	El Roble Field, Venezuela	Repressuring	.....	.....	Planning	.....	.....	.....	.....
Ipiranga S.A. Cia Brasilera de Petroleos	Rio Grande, Brazil	Therm. Crk. Ref.	2,000 bbls.	.....	Authorized	1952	Foster Wheeler	.....	.....
Mene Grande Oil Co.	Puerto la Cruz, Venezuela	Refinery	30,000 bbls.	.....	.....	.....	.....	.....	.....
Petroleos Mexicanos	Poza Rica, Mex.	Gas Purification Pressure Maint.	.....	$13 million	Under Constr.	Spring, 1950	.....	McKee	McKee
Petroleos Mexicanos	Salamanca, Mex.	Crd., Gasol, Crk.	25,000 bbls	$12 million	Under Constr.	Spring, 1950	U.O.P.	McKee	McKee
*Petroleos Mexicanos	Reynosa, Tamaulipas, Mex.	Refinery	5,000 bbls.	.....	Planned	.....	.....	.....	.....
Phillips Oil Co.	San Roque Fld., Anzoategui, Ven.	Refinery, Wax Fit.	2 mln lbs. Wax/ year	.....	Planning	1952	.....	.....	.....
Puerto Rican Oil Refining Co.	Near Ponce, Puerto Rico	Refinery	25,000 bbls.	$20 million	Projected	1st Qtr., 1951	Undetermined	Parsons, Brinckerhoff, Hall and Macdonald	.....
Refinaria de Petroleos do Distrito Federal S.A.	Rio de Janeiro, D. F. Brazil	Therm. Crk.	10,000 bbls.	.....	Authorized	.....	.....	.....	Fives, Lille, Schneider, Staff
Refinaria e Exploracao de Petroleo Uniao S.A.	Capuava, Sao Paulo, Brazil	Therm. Crk. Ref.	20,000 bbls.	.....	Authorized	.....	.....	P. A. Hydro. Res.	Foster Wheeler Czech, Fact. Metal Work Mech. Constr.
Richmond Exploration Co.	Bajo Grande, Venezuela	New Refinery	25,000 bbls.	.....	Engineering	June, 1950	.....	.....	.....
Shell Caribbean Pet. Co.	La Paz, Venezuela	Gas Plant	90 tons	.....	Under Constr.	Spring, 1950	.....	.....	.....
Shell Caribbean Pet.	Mara, Ven.	Gas Plant	90 tons	.....	Projected	Early 1951	.....	.....	.....
Venezuelan Gulf Refining Co.	Puerto la Cruz, Venezuela	Refinery	30,000 bbls.	$5 million	Under Constr.	July, 1950	.....	Lummus	Lummus



DRESSER engineering COMPANY

—Submits the Maysville Plant as an example of its design and construction facilities

706 So. Boston, Tulsa, Okla.

Specify INCONEL . . . the ECONOMY metal for HIGH-TEMPERATURE chemical processing

1. HIGH STRENGTH

2. OXIDATION RESISTANCE

3. RESISTANCE to CHEMICAL ATTACK

INCONEL IS STRONG

Strength, especially *hot-strength*, is the quality designers look for first in metals to be used in high-temperature applications.

INCONEL* *has exceptionally high hot-strength.*

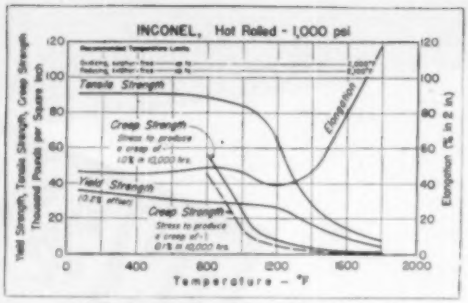
In the heat-treating field, where equipment is constantly exposed to red-heat temperatures, INCONEL has repeatedly set long-time performance records. One fixture made of INCONEL carried full work loads for 13,000 consecutive hours at operating temperatures of 1600° to 2150° F.

INCONEL RESISTS OXIDATION

A metal may resist oxidation at normal temperatures . . . but will it resist oxidation at the high temperatures necessary in processes like natural gas cracking?

INCONEL *will!*

Here's proof: In high-temperature enamel-setting furnaces where oxidation spalling of fixtures cannot be tolerated for fear of ruining expensive finishes – you'll find INCONEL hanger bars standard equipment. INCONEL's tightly-adhering oxide film does not scale to cause product contamination.



Tensile properties of hot-rolled Inconel.

INCONEL RESISTS CORROSION

Where atmospheres are sulfur-free, INCONEL has a plant-proved performance record in successfully handling hot corrosive chemicals such as fatty acids, molten salts, burning gases, sintered metals, ore reductions, and certain organic chemicals at elevated temperatures.

INCONEL IS ECONOMICAL

Get a quotation on INCONEL. You will find it less than you would probably expect. In addition, INCONEL's superior service life and low maintenance requirements often result in outstanding long-run economies.

For economy *plus* serviceability . . . *choose* INCONEL. INCO's Technical Service will gladly help with your specific problems. Your inquiries are always welcome!

*Reg. U. S. Pat. Off.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCONEL*... for long life at high temperatures

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Venezuelan Pet. Co.	Puerto la Cruz, Venezuela	Refinery	35,000 bbls.	.....	Under Constr.	.....	.....	Snare	Snare
Yacimientos Petroliferos Fiscales	Buenos Aires, Argentina	New Refinery	26,000 bbls.	$54 million	Engineering	Late 1950	.....	Kellogg	Kellogg
YPF	La Plata, Argentina	Crude Topping, Gasc Treating	80,000 bbls.	$2.8 million	Under Constr.	Spring, 1950	.....	Houdry Process Cat. Constr.	Cat. Constr.
YPF Bolivianos	Cochabamba, Bolivia	Topping & Reforming Units	5,000 bbls.	.....	.....	3rd Qtr., 1950	.....	Foster Wheeler	Foster Wheeler
Europe and Africa									
Anglo-American Oil Co.	Fawley, Eng.	Refinery Expansion	110,000 bbls.	$150 million	Under Constr	Late 1952	.....	Foster Wheeler	Foster Wheeler
Anglo-American	Fawley, Eng.	SO_2 Extraction	13,000 bbls.	.....	Design	.....	.....	Badger	Badger
Anglo-Iranian Oil	Isle of Grain, Eng.	Cent. Refg. Unit	60,000 bbls.	$120 million	Planning	1952	.....	.....	.....
Anglo-Transvaal Consolidated Investment Co.	Vall River, Union of South Africa	Synthetic Gasoline and Diesel Oil Plant	.....	$50-60 million	Contracted	.....	.....	Hydro. Res.	.....
Aquila, S.A.	Trieste, Italy	Lube Oil Ref.	800 bbls.	$7.9 million	Design	Mar., 1951	Juik, Texaco	Badger	Badger
Azienda Generale Italiana Petroli	Rome, Italy	Add to Plant	24,000 bbls.	.....	Projected	Late 1951	.....	.....	.....
Azienda Generale Italiana Petroli	Palermo, Italy	Marine Fuel Plant	7,500 bbls.	.....	.....	.....	.....	.....	.....
Bataafsche Petroleum Mij.	Pernis, Holland	P.U.C. Plant	2,000 tons, yr.	.....	.....	Spring, 1950	.....	.....	.....
My. Bataafsche Pet.	Pernis, Holland	Expansion	50,000 bbls.	.....	Under Constr.	Mid 1952	.....	.....	.....
British Petroleum Chem.	Grangemouth, Scotland	Petrochem	.....	.....	Under Constr.	Dec., 1950	.....	Stone & Webster	Stone & Webster
Cabot Carbon, Ltd. (Godfrey L. Cabot, Inc.)	Ellesmere Port, Eng.	Carbon Black Plant	50,000 lbs., yr.	.....	Under Constr.	1950	.....	Simon-Carves, Ltd.	Simon-Carves, Ltd.
Cie. de Raffinage Shell-Berre	Berre, France	Expansion	26,000 bbls.	$31.6 million	Under Constr.	Mid 1951	.....	.....	.....
Shell	Petit-Couronne	Teepol Plant	25,000 tons, yr.	.....	.....	Mid 1950	.....	.....	.....
Cie. de Raffinage Shell-Berre	Petit Couronne, France	Lube Unit	.....	.....	Planned	.....	.....	.....	.....
Cie. de Raffinage Shell-Berre	Petit-Couronne (Rouen), France	Expansion	10,000 bbls.	.....	Under Constr.	2nd Qtr., 1950	.....	.....	.....
Cie. Francaise de Raffinage	Gonfreville, France	Lube Unit	2,500 bbls.	.....	Design	1951	Texaco	Kellogg-Lummus	.....
Cie. Francaise de Raffinage	Gonfreville, France	Distillation Unit	20,000 bbls.	.....	Under Constr.	3rd Qtr., 1950	.....	Foster Wheeler	Foster Wheeler
Cie Francaise de Raffinage	Provence, France	Topping Unit	20,000 bbls.	.....	Under Constr.	4th Qtr., 1950	.....	Foster Wheeler	Foster Wheeler
Cia Espanola de Petroleos, S.A.	Sta. Cruz de Tenerife, Canary Islands	Propane-Butane Fractionating.	204 bbls.	$100,000	Contracted	Late 1950	.....	U.O.P.	U.O.P.
C.E.P.S.A.	Canary Islands	Propane-Dens.	700 bbls	$300,000	Contracted	Late 1950	Standard Oil	Foster Wheeler	Foster Wheeler
C.E.P.S.A.	Canary Islands	Furl. Ref. Sol. MEK Dewax.	425 bbls.	$4.5 million	Under Constr.	Mid , 1950	Texaco	Foster Wheeler	Foster Wheeler
Condor, S.P.A. Per l Industriale Pet. Chimica	Rho, Italy	New Refinery	1 mln tons, yr.	.....	.....	.....	.....	.....	.....
Danish Government	Denmark	Refinery	21,000 bbls.	.....	Planned	.....	.....	Lummus	Lummus
Egyptian Government	Cairo, Egypt	Crude Plant	.....	.....	.....	.....	.....	.....	.....
Industrie Chimiche Italiane Pet-oli	Mantua, Italy	Crude	4,500 bbls.	.....	.....	.....	.....	.....	.....
Industria Naz. Inne Petroli e Trasformazione	Massa Carrara, Italy	Refinery	40,000 bbls.	.....	.....	Late 1951	.....	.....	.....
Industria Petrolifera Chimica	Milan, Italy	Gasoline Fuel Oil Plant	20,000 bbls.	.....	.....	.....	.....	Dr. Calogero Inglogio	.....
Imperial Chemical Industries, Ltd.	Wilton, Yorkshire, England	Petroleum Cracking Unit	.....	.....	Under Constr.	End 1950	.....	Kellogg	Kellogg
L'Alliance Petrofina	Antwerp, Belg.	Refinery	21,000 bbls.	.....	Planned	.....	.....	.....	.....
Manchester Oil Refinery, Ltd.	Partington, England	Cat. Crk., Lube Reforming	20,000 bbls.	.....	Projected	.....	.....	.....	.....
Monsanto Chemical Co.	Britain	Add Polystyrene	.....	.....	Under Constr.	Early 1950	.....	Staff	Staff
National Oil Refineries	Llandarcy, Wales	Furf. Ref. Srl. Dewax, Wax Fractn.	1,200 bbls.	$36 million	Designing	Early 1953	Texaco	Badger	Badger
National Oil Refineries	Llandarcy, Wales	SO_2 Solvent Extraction	3,000 bbls.	.....	Contracted	Early 1951	.....	H.W.P.	H.W.P.
Pechelbronn, S. A. E. M.	Merkwiller, France	Capacity Increase	1,550 bbls.	.....	Authorized	1950	.....	.....	.....
Petroarbon, Ltd.	Partington, England	Cat. Cracker, Lube & Reform	20,000 bbls.	.....	.....	.....	.....	.....	.....
Petro Chem., Ltd.	Partington, England	Petrochemicals	2,000 bbls.	$16 million	Under Constr.	Early 1950	Petro-Carbon	Petro-Carbon	Petro-Carbon
Philblack, Ltd.	Avonmouth, England	Carbon Blk. Plt.	137,000 bbls.	$5 million	Contracted	Aug., 1950	Phillips	H.W.P.	H.W.P.
Ref. de Pet. de Escom. S.A.	Escombreras, Spain	Add Refinery	20,000 bbls.	.....	Under Constr.	Oct. 1, 1951	.....	.....	.....
Ref. Belge	Antwerp, Bel.	Atmos., Vac. Distill.	7,000 bbls.	$1.5 mln.	Planning	June, 1951	.....	.....	.....
Raffinerie Belge de Petroles S.A.	Antwerp, Belgium	Therm. Crk., Reform., Gas Plant	7,000 bbls.	$2 million	Under Constr.	June, 1950	.....	Barnes	Barnes
Raffineries Francaises de Petrole de l'Atlantique	St. Nazaire, France	Consolidate Refineries	7,100 bbls.	$9.4 million	.....	.....	.....	.....	.....
Raffinerie Siciliane Oli Minerali, Sp.A.	Augusta, Sicily	Crude Refinery	10,000 bbls.	.....	Under Constr.	July, 1950	U.O.P.	U.O.P., Delta, Staff	Staff
Scottish Oils, Ltd.	Grangemouth, Scotland	Stage I: 1 Pipe Still Distill., Steam Boil. & Power Plt.	1.5 mln. tons per Yr. 20,000 kw	.....	Under Constr.	End 1950	.....	Kellogg	Kellogg
Scottish Oils	Grangemouth, Scotland	Stage II: Cat. Crk., Vac. Distill., Cat. Poly Plt., & Trtng Plt.	.....	.....	Planned	Mid., 1952	.....	.....	.....
Scottish Oils, Ltd.	Grangemouth, Scot.	Buoyancy Foundations	.....	.....	Under Constr.	End 1950	.....	Rendel Palmer and Tritton	.....
Shell Chemical Mfg. Co., Ltd.	Thornton, Eng.	Teepol Plant Extension	75,000 tons per Year	.....	Under Constr.	Spring, 1950	.....	.....	.....
Shell Refining & Marketing Co., Ltd.	Stanlow, Eng.	Comprehensive Refining	60,000 bbls.	.....	Under Constr.	Early 1952	.....	.....	.....
Shell Refining & Marketing Co., Ltd.	Shell Haven, England	Comprehensive Refining	40,000 bbls.	$34 million	Under Constr.	Mid 1953	.....	.....	.....

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Societe Generale des Huiles de Petrole	Lavera, France	LPG Units	25,000 bbls.		Under Constr.	Mid 1950	Kellogg	Kellogg	Staff
Societe Generale	Dunkirk, France	Crude Reform.	35,000 bbls.		Under Constr.	Mid 1951	Lummus, Kellogg	Lummus, Kellogg	Lummus, Kellogg
Societe Generale	Dunkirk, France	Furf. Ref. Sol. Dewax., Wax Fractn.	2,800 bbls.		Designing	Mid 1951	Texaco	Lummus	Lummus
Societe Generale	Dunkirk, France	New Refinery	6,000 bbls.		Under Constr.	End, 1951			
Societe Industrial Belgique de Petrole	Antwerp, Belgium	Crde., Crk. Ref.	30,000 bbls.		Designing	Mid 1951			
Societe Raffinazione Oli Minerali (IROM)	Porto Marghera, Italy	Atmospheric & Vac. Distill., Acid Treat., Contact Filtration for Lube Oils, Electric Gen. Unit, Load. Facilities	11,600 bbls.	$6.4 million	Contracted			H.W.P.	H.W.P.
Societe per Azioni Raffineria Padana Oli Minerali	San Martino di Trecate, Italy	Refinery	13,000 bbls.		Proposed				
Socony-Vacuum Francaise	Notre Dame de Gravenchon	MEK Unit	1,000 bbls.		Design	Mid 1950	Texaco	Lummus	Staff
Socony-Vacuum Francaise	Notre Dame de Gravenchon	Propane Dewaxing	1,160 bbls.		Design	Mid 1950	Jeik	Lummus	Staff
Socony-Vacuum Francaise	Notre Dame de Gravenchon	Grease and Compounding			Under Constr.	Mid 1950		Staff	Staff
Socony-Vacuum Italiana, S.p.A.	Naples, Italy	Visbreaker				Spring, 1950		Staff	Staff
Socony-Vacuum Italiana, S.p.A.	Naples, Italy	Topping Unit	15,000 bbls.		Under Constr.	Spring, 1950		Staff	Staff
Socony-Vacuum Italiana, S.p.A.	Naples, Italy	Solvent Treating	1,000 bbls.		Under Constr.	Spring, 1950	Texaco	Staff	Staff
Socony-Vacuum Italiana, S.p.A.	Naples, Italy	Reformer	3,000 bbls.		Under Constr.	Spring, 1950		Staff	Staff
Stand.-Azienda Gen. Indro. Comb. (Stanic)	Leghorn, It.	Add Capacity	28,700 bbls.						
Ditto (Stanic)	Bari, Italy	Add Capacity	38,300 bbls.						
Standard Francaise des Petroles	Port Jerome, France	Dewaxing Plant	1,200 bbls.	$6.4 million	Design	Late 1951		S.O.D.	Foster Wheeler
Standard Francaise des Petroles	Port Jerome, France	Deasphalting Plant	1,500 bbls.		Design	Late 1951		S.O.D.	
Standard Oil Co., (N.J.)	Belgium	Dist. Crack.	33,000 bbls.		Planned	Early 1952			
Trent Oil Prod. Development Co.	North Shields, England	Crude Plant	11,500 bbls.	$4.8 million	Plans approved				
Union Petrol Refinery, Ltd.	Johannesburg, Union of South Africa	New Refinery		$20 million	Projected				
*Vacuum Oil Co., Ltd.	Coryton, Eng.	Lube Refinery	20,000 bbls.	$30 mln.	Planned	Sept., 1952			
Near East									
Anglo-Iranian Oil	Abadan, Iran	Gas Plant	25,000 mcf	$2 million	Under Constr.	1950		Badger	Badger
Anglo-Iranian	Abadan, Iran	Cat. Cracker	30,000 bbls.		Under Constr.	1951		Foster Wheeler	Foster Wheeler
Anglo-Iranian	Abadan, Iran	Solvent Dewax.	700 bbls.		Under Constr.	4th Qtr., 1950	Texaco	Badger	Badger
Anglo-Iranian	Abadan, Iran	Gas Recov., Stab.	22,000 mcf		Under Constr.	Mar., 1951		Badger	Badger
Arabian American Oil Co.	Abqaiq, Saudi Arabia	Crude Oil Stabilizer	300,000 bbls.	$4.5 million	Under Constr.	Dec., 1950		Staff and Fluor	Fluor
Arabian American	Ras Tanura, S.A.	Asphalt Plant	500 bbls.	$1.25 mln.	Under Constr.	1950		Staff, Bechtel	Staff
Bahrein Pet. Co., Ltd.	Bahrein Island	Crd. Still Util.	55,000 bbls.	$9.1 million	Under Constr.	Aug., 1950		Lummus, Bechtel	Int. Bechtel, Inc.
Consolidated Ref., Ltd.	Haifa, Palestine	Crude Plant	80,000 bbls.		Planned	Late, 1951		Badger	Badger
Consolidated Ref., Ltd.	Haifa, Palestine	Cen. Facilities			Under Design			Badger	Badger
Consolidated Ref., Ltd.	Haifa, Palestine	Lube Plant	2,500 bbls.		Designing		Texaco, Jeik	Lummus, Kellogg	Lummus, Kellogg
Far East									
Batanfaehe Pet. Mij. (Shell)	Balikpapan, Borneo, East Indies	Expansion	42,000 bbls.		Under Constr.	Mid 1952			
Batanfaehe Pet. Mij.	Pladjoe, Sumatra	Rehab. to Comprehensive Refg.	70,000 bbls.		Under Constr.	Mid 1951			
Burmah Oil Co., Ltd.	Syriam, Burma	Furf., Sol. Dewax., Wax Mfg.	1,000 bbls.	$600,000	Designing		Texaco	Badger	
Burmah Oil Co.	Syriam, Burma	Thermofor Clay Revivification	960 tons	$150,000	Engineered	1950	Max Miller, Socony-Vacuum	Max Miller	
Pacific Refineries, Ltd.	Honolulu, Hawaii	Butane, Asph., Gas Oil, Lt. Fretns. Refy.	3,000 bbls.	$1.5 million	Contracted	June, 1950		Fish Eng	Fish Eng
*Toa Nenryo Kogyo, Ltd.	Sehimizu, Japan	Refinery	4,000 bbls.		Under Constr.	Spring, 1950			
*Toa Nenryo Kogyo, Ltd.	Wakayama, Japan	Refinery	6,000 bbls.		Under Constr.	April, 1950			
Oceania									
Australian Shell Oil Co.	Clyde, New S. W., Australia	Lubeol Refining	200 bbls.		Under Constr.	Late 1950			
Australian Shell Oil Co.	Geelong, Victoria, Australia	New Refinery		$4.8 million	Under Constr.	Late 1951			
Australian Shell Oil Co.	Geelong, Victoria, Australia	Bitumen and Lubeol Plant			Projected				
Australian Shell Oil Co.	Geelong, Victoria, Australia	Asphalt, Lube Sol. Extct Plt.							

* First appearance in tabulation. † Added capacity.

NOTE: Austin—Austin Co. Badger—E. B. Badger & Sons. Barnes—W. M. Barnes & Co. Bechtel—Bechtel Corp. Bellows—W. S. Bellows Co. Blaw-Knox—Blaw-Knox Construction Co. Bowden—W. H. Bowden. Braun—C. F. Braun Co. Brown Eng.—Brown Engineering Co. Brown & Lite—Brown & Lite Co. Brown & Root—Brown & Root Construction Co. Can. Kellogg—Canadian Kellogg Co. Cat. Constr.—Catalytic Construction Co. Chemico—Chemical Construction Co. C.B.&I.—Chicago Bridge & Iron Works Co. Clarke—Clarke Construction Co. Constr. Service—Construction Service Co. Delta—Delta Engineering Corp. Dresser—Dresser Engineering Corp. E.&A.—Ehrhart & Arthur, Inc. Ferguson—H. K. Ferguson. Fish Eng.—Fish Engineering Corp. Fluor—Fluor Corp. Foster Wheeler—Foster Wheeler Corp. Gaso. Plant—Gasoline Plant Construction Co. General American—General American Transportation Co. Girdler—The Girdler Corp. Graff—Graff Engineering & Equipment Co. Grebe & Doremus—Grebe & Doremus Process Co. Hammond—Hammond Iron Works Co. Harris—John W. Harris Associate, Inc. Houdry—Houdry Corp. Howard-Mitchell—Howard-Mitchell Construction Co. Hudson—Hudson Engineering Corp. H.W.P.—Head Wrightson Process, Ltd. Hydro Res.—Hydrocarbon Research, Inc. Ind. Eng.—Industrial Engineers, Inc. J.&L. Constr.—Construction Division, Jones & Laughlin Supply Co. Kellogg—M. W. Kellogg Co. Koch—Koch Engineering Co. Koppers—Koppers Co., Inc. Knowles—Morris Knowles & Co. Knutson—Knutson Construction Co. Leonard—Leonard Construction Co. Lummus—The Lummus Co. Mahoney—Mahoney Contracting Co. Mason—Mason Brothers Construction Co. Mathews—Mathews Conveyor Co. McKee—Arthur G. McKee Co. Max Miller—Max B. Miller & Co. Michael Poling—Michael-Poling Construction Co., Inc. Montgomery—J.&M. Montgomery & Co. P. A. Hydro Res.—Pan American Hydrocarbon Research, Inc. Parsons—The Ralph M. Parsons Co. Perco—Division Phillips Petroleum Co. Pet. Eng.—Petroleum Engineering, Inc. Petreco—Petroleum Rectifying Co. Pritchard—J. F. Pritchard Co. Pro. Eng.—Process Engineers, Inc. Process Constr.—Process Construction Co. Ref. Eng.—Refinery Engineering Co. Ref. Maint.—Refinery Maintenance Co., Inc. Rust Eng.—Rust Engineering Co. Rust Pro.—Rust Process Design Co. Schneider—Schneider & Cie. Snare—Frederick Snare Corp. Solitt—Summer S. Solitt Co. S.O.D.—Standard Oil Development Co. Stade Eng.—Stade Engineering Co. Stearns-Roger—Stearns-Roger Manufacturing Co. Stone & Webster—Stone & Webster Construction Co. Tellepsen—Tellepsen Construction Co. Texaco—Texaco Development Co. U.O.P.—Universal Oil Products Co. Utah—Utah Construction Co. Voorhees, Walker, Foley & Smith. Waleo—Waleo Engineering. West—F. S. West Construction Co. White—J. H. White Eng. Corp. Wohlfeld—Wohlfeld Construction Co. Equally owned California Texas Corp. and Socony-Vacuum Oil Co., Inc.

These are among the leading petroleum companies with Kellogg designed-and-constructed Propane Deasphalting and Decarbonizing units:
• Anglo-Iranian Oil Company, Ltd.
• British American Oil Co., Ltd.
• Cities Service Refining Corp.
• Cie. Francaise de Raffinage
• Gulf Oil Corporation
• Humble Oil & Refining Co.
• Kendall Refining Company
• Mid-Continent Petroleum Co.
• The Pennzoil Company
• Phillips Petroleum Company
• Pure Oil Company
• Shell Oil Company
• Sinclair Refining Company
• Standard Oil Company (Ohio)
• The Texas Company
• Utah Oil Refining Company

4 out of every 5 barrels of Propane-Deasphalted oil are processed in Kellogg-designed units!

Yes! Kellogg has engineered and built over four-fifths of the world's Propane Decarbonizing and Deasphalting capacity . . . and there's more under construction!

WHEN it became obvious years ago that asphalt-free crudes would not meet the growing demand for lubricating oil stocks, development work was started to obtain quality lube stocks from asphaltic crudes. Eventually this development work grew into the familiar JUIK (Jersey-Union-Indiana-Kellogg) series of propane processes, basic among which was Propane Deasphalting. First utilized successfully as a settling process in horizontally-positioned equipment, Kellogg later developed the present counter-current tower method.

Efficient, non-critical in operation, and extremely flexible over a wide range of feed and product specifications, Kellogg engineers subsequently saw in the basic principles of the process an excellent method for reducing the carbon content of cat cracker feed stock, thus increasing the potential capacity of any cat cracker. Kellogg has designed and sold such units since 1942.

As licensing agent for all such projects, and as the designer and builder of more than four-fifths of the world's capacity, M. W. Kellogg offers unduplicated background to refiners considering addition of such facilities.

PILOT PLANTS PLAYED MAJOR ROLE IN PERFECTING PROPANE DEASPHALTING!

If any refining process owes its acceptance to pilot plant work, most certainly it is Propane Deasphalting. Kellogg's first pilot plant for this process was started back in the early thirties. It was followed by others, including the latest pilot unit pictured here. Operating characteristics and economics were so thoroughly investigated on these pilot plants in hundreds of separate runs that widespread commercial acceptance of the process was achieved practically overnight on the basis of pilot plant data.

IT TAKES ALL SEVEN TO PRODUCE GREATER EARNING POWER . . .

3. SPECIALISTS IN EVERY PHASE
of DESIGN ENGINEERING in true depth. There are, for example, 14,000 square feet of floor space devoted to piping engineering alone . . . eight separate divisions to parallel the eight major phases of refinery engineering: piping, heat transfer, vessel and furnace, equipment, instrumentation, structural, electrical and operation. And behind this array of personnel is an exclusive compilation of data, continually created and collected during more than thirty years of the oil refining industry's greatest growth. From "Equilibrium Constants" to "Design of Piping Systems," both considered authoritative tracts within the industry, to special standardized templates for drawings, the Kellogg organization puts in the hands of its Engineering Division every necessary "tool" to deliver outstanding performance.

1 THE DEVELOPMENT "TOOLS"
—laboratories, pilot plants and recognized specialists to prove and improve processing and equipment ideas.

2 PROCESS ENGINEERING
by three distinct groups of specialists—*sequence* engineers, *unit* engineers and *development* engineers—supported by an extensive reservoir of exclusive data.

4 SPECIALIZED BUYERS
backed by the cumulative buying power of the largest company in the business.

5 COMPLETE FABRICATING FACILITIES
to make schedule, deadlines and to develop workable "firsts" in refinery equipment.

6 CONSTRUCTION KNOW-HOW
acquired in completing hundreds of major jobs, plus an ample supply of the proper tools, and the constant development of new money-and-time-saving methods on the construction lot.

7 PRACTICAL OPERATING COUNSEL
on all design and construction, achieved through practical operating men working as an integral part of the company.

. . . AND ONLY KELLOGG HAS ALL SEVEN!

The M. W. Kellogg Company, (a subsidiary of Pullman, Inc.), New York, Jersey City, Los Angeles, Tulsa, Houston, Toronto, London, Paris

Gasoline Plant Supplies Naphtha For Catalytic Reforming Unit

LEON DORSEY

Operations Superintendent, McCarthy Chemical Company, Winnie, Texas

PETROLEUM REFINER
APRIL, 1950

LIGHT HYDROCARBONS ISSUE

THE fourth unit of the McCarthy Chemical Company at Winnie, Texas, consists of a complete gasoline plant operating in parallel to the original gasoline plant[1] completed in 1945. These two plants are processing gas from several surrounding fields and supply sales gas pipelines with the residue gas.

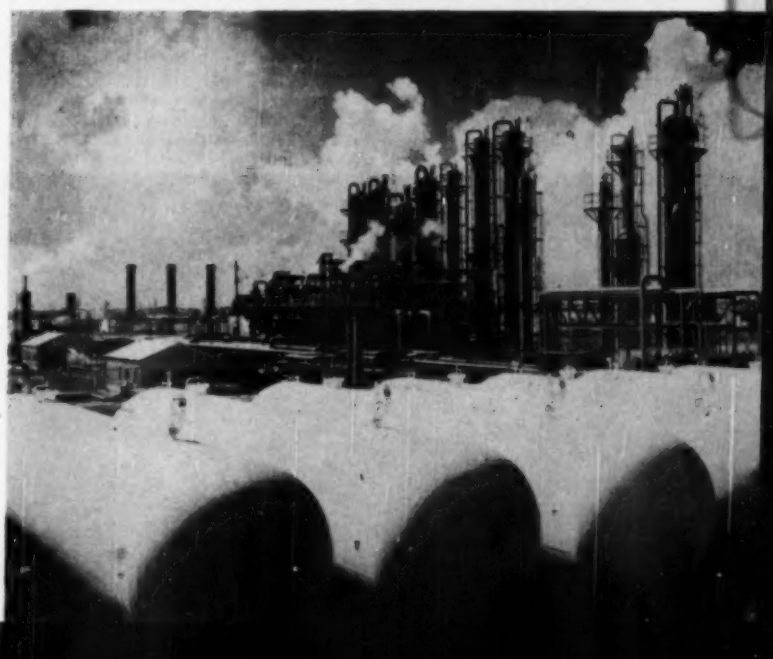
This latest unit was basically designed to process 85 million cubic feet per day of gas along with 4500 barrels of distillate. The plant produces propane, butane, 200-endpoint gasoline, naphtha, and kerosine.

***THE GASOLINE** plant described in this article incorporates a variety of features that might be termed "modern". The process scheme, for instance, utilizes a rich oil demethanizer to reduce the volume of noncondensable gases that must be handled by the stripping section of the unit. Both high and low-pressure stripping stills are provided, and total condensation of propane is achieved at the high pressure still overhead accumulator. The mechanical arrangement of the plant is perhaps even more noteworthy, because so much that is important to the process operation has been accomplished in this phase of the design. The use in natural gasoline plants of steel structures perhaps best described as "refinery type" is steadily increasing. Advantages claimed for these compact structures include greater ease of operation and a substantial reduction in the process piping requirements. Problems of pump suction head are largely eliminated, since the usual arrangement makes use of a top deck for condensers, a second deck for accumulators and reflux drums, and the ground space below the structure for process pumps.*

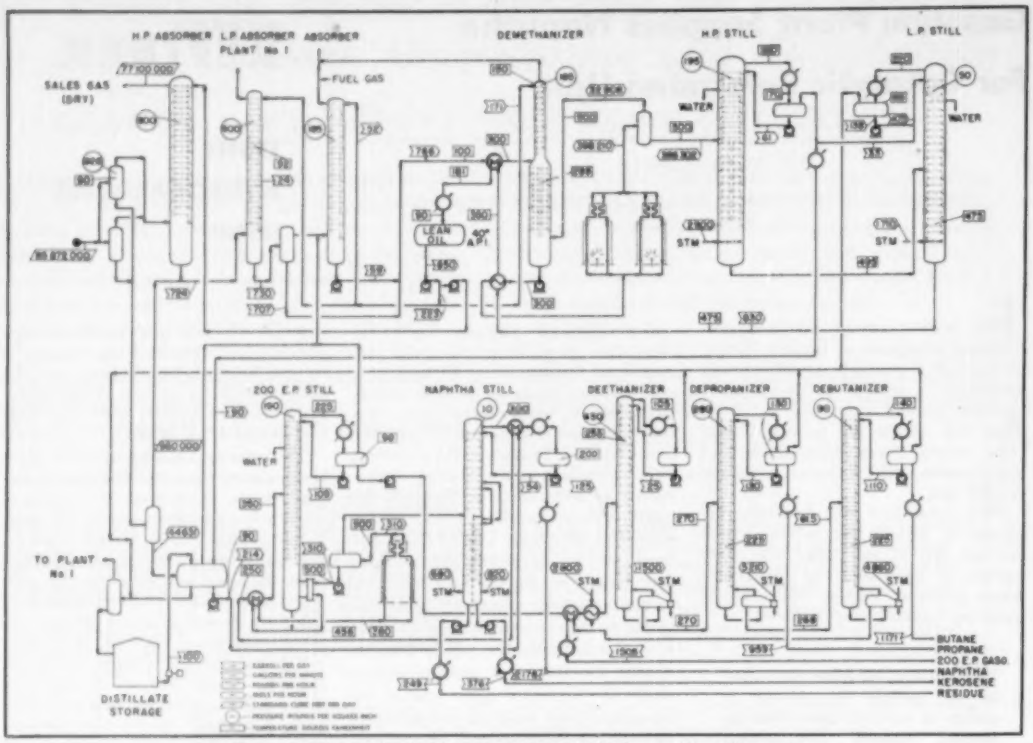
Generally, the physical layout of this plant is conventional, with all open-fired heaters being located at a safe distance from the process equipment, and the main control house centrally located. One deviation from the usual layout is in the process structure. This structure is of the "refinery-type," having all overhead condensers on the upper deck, accumulators on the lower deck, and all pumps located at ground level under the accumulators. This type structure provides several advantages besides economy. Grouping of the towers is quite compact, which reduces materially the piping between towers. Locating all process pumps under the structure also reduced the amount of pipe required and provided the suction head needed. One of the most important reasons for using this type of structure is the ease of operation afforded. It is possible for the operator to check all of the condensers on one level of the structure and the accumulators on another, which eliminates the time usually spent in climbing up and down ladders.

The physical equipment in the plant is similar to that found in most gasoline plants. It consists of a primary absorber, reabsorbers, rich oil stills and the usual three fractionators. There are several variations, however, from the usual process design of gasoline plants. A demethanizer is used for complete demethanization and partial deethanization of the rich oil stream, which reduces the volume of uncondensable gases charged to the still. This method provides total condensation of propane in the high pressure still accumulator without the interference of methane.

Another detail of the plant's design



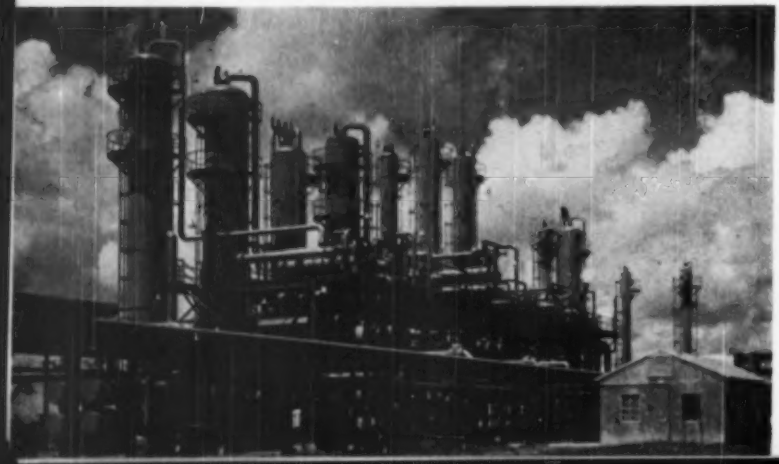
Gasoline plant No. 2 of the McCarthy Chemical Company at Winnie, Texas. Processing vessels (l-r) are the high-pressure still, low-pressure still, 200-endpoint still, naphtha-kerosine still, deethanizer, depropanizer, debutanizer, 500-pound absorber, 185-pound absorber, demethanizer, and high-pressure absorber. Boiler plant and rich oil heaters are at the left of the processing section. Central control room is in building at left center.



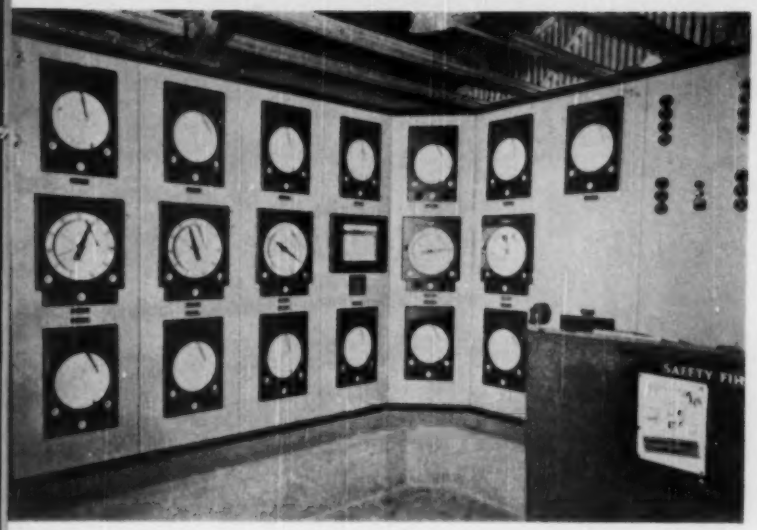
Flow Sheet of McCarthy Chemical Company's (Fourth Unit) Gasoline Plant, Winnie, Texas.

is utilization of a distillate surge-raw make drum. This drum serves as a flash drum for the field distillate, as well as a surge drum, and as a means of combining the unstabilized gasoline and the field distillate streams which make up the feed to the 200-endpoint gasoline still. A 200-endpoint still and a naphtha still are also unusual in a plant of this type. They are used to prepare a 200°-450° F. naphtha cut for feed stock to a catalytic reforming unit for premium motor gasoline production. The naphtha still incorporates some unusual mechanical design. The lower tower is partitioned into two sections. The regular tower stripping section, producing a gas-oil bottoms product, has semicircular bubble trays. The other half of the tower, also with semicircular bubble trays, is used as a side stream stripping tower for kerosine product which is drawn off of a tray in the upper section of this still. The two stripping sections are, of course, completely isolated by a partition wall.

The three absorbers of the plant operate at 800, 500, and 185 pounds. Inlet gas is separated from distillate liquids in parallel 825-psi. separators before entering the high pressure absorber. Distillate from these inlet gas scrubbers is flashed and the vapors are vented into the 500-psi. absorber. The remaining distillate from this 500-psi. flash drum flows to a 200-psi. accumulator where it is combined with unstabilized raw gasoline from the absorption and rich oil stripping section of the plant. Flash vapors from this accumulator are routed to the 185-psi. absorber. Rich oil from the 800-psi. absorber is flashed in the base of the 500-pound absorber. Rich oil from the 500-psi. absorber is flashed into a drum and the vapors vented to the 185-pound absorber. A liquid level instrument controls this flow of vapor to the 185-pound absorber. Liquid from this flash is combined with rich oil



Refinery type structure for process vessel utilities. Top deck is condenser deck, center is accumulator deck, and pump area is at ground level. Columns (l-r) high-pressure still, low-pressure still, 200-endpoint still, deethanizer, depropanizer, debutanizer, demethanizer, high-pressure absorber, 185-pound absorber, and 500-pound absorber. Control room building at lower right.



Portion of central control room panel. A second section of the same size is to left of this panel at opposite end of the room.

from the 185-psi. absorber, preheated by exchange with lean oil, and charged to the demethanizer at the top of its stripping section. Bottoms from the demethanizer are further heated by exchange with lean oil and then charged to rich oil heaters—two two-pass direct fired units. The furnace effluent is flashed and vapors are recycled to the bottom of the demethanizer.

This stream is rich in propane and the differences in the partial pressures of the components cause propane to be absorbed preferentially by the rich oil in the stripping section while considerable methane and ethane are released from the liquid phase. These gases flow upward into an absorption section, together with the gases flashed from the inlet stream of rich oil. It is interesting to note that the rich oil heaters, primarily intended as preheaters for rich oil stripping, serve a second purpose—as reboilers for the demethanizer. Heating these recycle vapors from the rich oil provides better stripping of ethane from the rich oil than would be possible with cold recycle gas.

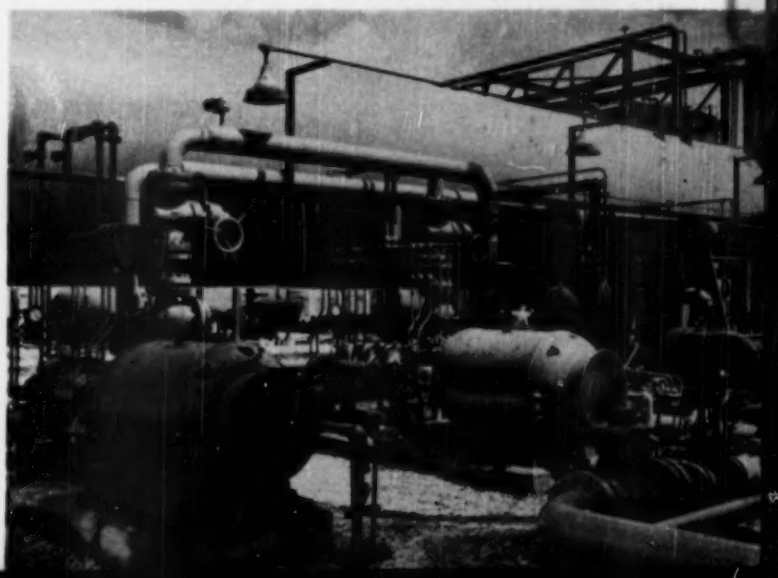
A liquid level control is employed to dump excess liquids to atmospheric storage from the distillate-raw gasoline accumulator, and a flash drum is employed to separate volatile components from this liquid flow. If the contents of this accumulator are charged to the product fractionating channel in excess of receipts from the field and stills, a low level alarm in the control room gives the alarm and distillate is pumped back into the drum from storage.

As mentioned previously, the field distillate and unstabilized natural gasoline combined make up the charge to the 200-endpoint still. This charge, on flow control, is sufficiently heated by exchange with other streams to obtain the desired vaporization as it is charged to the still. The overhead product from this still is an unstabilized 200° F. endpoint gasoline, which constitutes the charge to the deethanizer. The temperature at the bottom of the still is maintained by a circulation of oil through a heater on temperature control, a hot oil surge drum, and a vertical reboiler. The bottoms from the still are combined with this circulating oil before it goes through the heater and is flashed in the surge drum. This flashed material is the charge to the naphtha still. A drag stream of hot lean oil is also introduced at this point, which affords a means of keeping the lean oil clean.

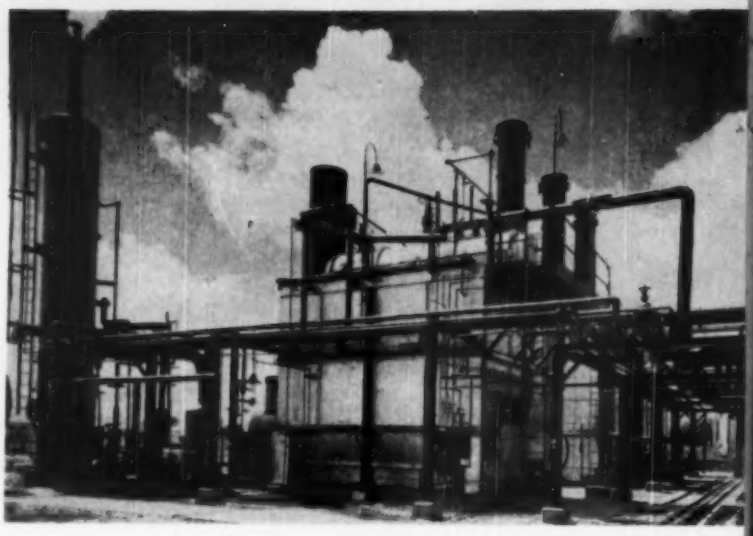
The overhead from the naphtha still is a 200°-450° F. naphtha cut which forms the charge to a catalytic reforming unit in which premium motor gasoline is made. The internal side stripper is used in this still to make a kerosine cut, and the bottom product is a 35° API gasoil.

The feed to the deethanizer is initially heated by exchange with the stabilized 200-endpoint gasoline and is finally heated on temperature control with a steam preheater. The net overhead, non-condensables, is sent to the suction of the sales gas booster compressors in the Plant No. 1. The rate at which these non-condensables are withdrawn is controlled by a pressure controller and the level in the accumulator is controlled by the reflux rate. The bottoms from the deethanizer go to the depropanizer as the charge.

A 95 percent or higher purity propane product is made as overhead on the depropanizer. A flooded overhead condenser system is employed on this tower. Tower pressure is used to control the withdrawal of propane overhead product. As pressure rises on the tower, a valve controlling the flow to storage of propane product is opened wider and the rate of product removal thus increased. This in turn causes the liquid level maintained in the flooded overhead product condenser to fall and expose more tubes in the condenser. Increased gas phase



High-pressure lean oil pumps, driven by electric motors, are located at the base of the high pressure, 500, and 185-pound absorbers.



Only one boiler was installed at No. 2. Additional steam is supplied from excess capacity of the boilers at plant No. 1 in a common header. This 30,000-pound-per-hour boiler operates at 200 psig.

condensing surface in turn condenses more of the overhead vapors and tower pressure falls. The system reaches an operating equilibrium condition which can be readily adjusted by selection of the tower pressure. The method achieves total condensation of the overhead and eliminates the venting of propane vapors to control the tower pressure. An auxiliary pressure controller is employed at start-up until sufficient overhead is made to put the flooded system in operation.

The bottoms from the depropanizer are charged to the debutanizer. The overhead product from this tower is a 95 percent or higher butane and the bottom is a stabilized 200° endpoint gasoline. The pressure control system of this tower is identical with that of the depropanizer. The "debutanizer" is operated as a stabilizer to control the vapor pressure of the 200° endpoint gasoline, as this material is blended back with the reformed gasoline fraction to obtain any desired vapor pressure on the finished gasoline. The butane is either blended with a portion of the propane to make LPG or is charged with the mixed-butane stream from Plant No. 1 to a deisobutanizer.

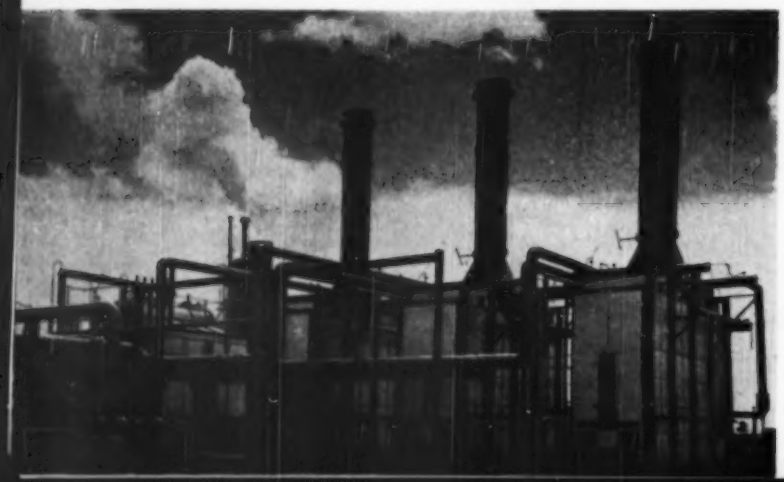
Utilities

Steam is normally furnished this plant by one 30,000-pound boiler operating at 200 psig. The feed to the boiler is taken from a strip heater, which in turn receives all condensate from the skim tank and reboilers. The level in the strip heater is maintained by the addition of treated water from a water treating unit in Plant No. 1. The firing of this boiler is fully automatic, with the flow of fuel gas being governed by the steam pressure. Induced draft is provided by a turbine driven blower, the speed of which is governed by a ratio controller between the flow of fuel gas and the draft. Only one boiler was provided in this plant, as both gasoline plants and the chemical plant are looped with a common steam header. Sufficient steam from the other plants is available to spare the one boiler.

The cooling water is circulated by electric-motor driven centrifugal pumps, with the discharge of these pumps split into two streams. The primary stream supplies pump gland cooling water and flows through most of the condensers and coolers in the plant. The secondary stream goes first through the final lean oil coolers, then on to the rest of the coolers and condensers. A back-pressure regulator is employed on the secondary line to insure a balanced flow of water through both streams. All the water is returned to the cooling tower through one common header. Sulfuric acid and phosphates are added for scale and corrosion control and chlorine is added for algae control. Make-up water is furnished from water wells adjacent to the plant.

Instrument and plant air is furnished by two air compressors, one electric driven and one driven by a steam turbine.

The process of the plant was designed by Petroleum Engineering, Inc., and construction was under the general supervision of McCarthy Chemical Company, Engineering Department, with Carruth Contracting Company of Texas, Incorporated; Fisback and Moore, electrical contractors and engineers; Westheimer Rigging and Heavy Hauling Company, Incorporated; Thermal Products Company; and Industrial Painters and Sandblasters Company, Incorporated, as subcontractors.



Two of these heaters are used for heating rich oil charged to the high-pressure still. These heaters also serve a second purpose—as reboilers for the demethanizer by heating the recycle vapors from the rich oil. The third heater is used to maintain the temperature at the bottom of the 200-endpoint still and to vaporize the charge to the naphtha still.

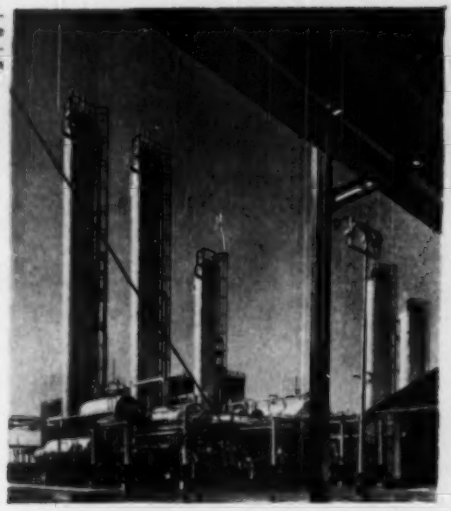
REFERENCE

1 "High- and Low-Pressure Processing Combined in McCarthy Plant," Petroleum Refiner, July, 1946, page 89.

ACKNOWLEDGMENT

The writer wishes to express his appreciation to M. V. Dunk, plant superintendent, McCarthy Chemical Company, and to Norman K. Rector, Petroleum Engineering, Inc., for their aid in editing this manuscript.

At right—Debutanizer, depropanizer, deethanizer, and low-pressure and high-pressure stills of new unit of TXL gasoline plant. Accumulators for the vessels are elevated on a single-story structure at the base of the vessels. The fractionation pump building is at the extreme right.



Shell-Texaco Increase Capacity of TXL Plant

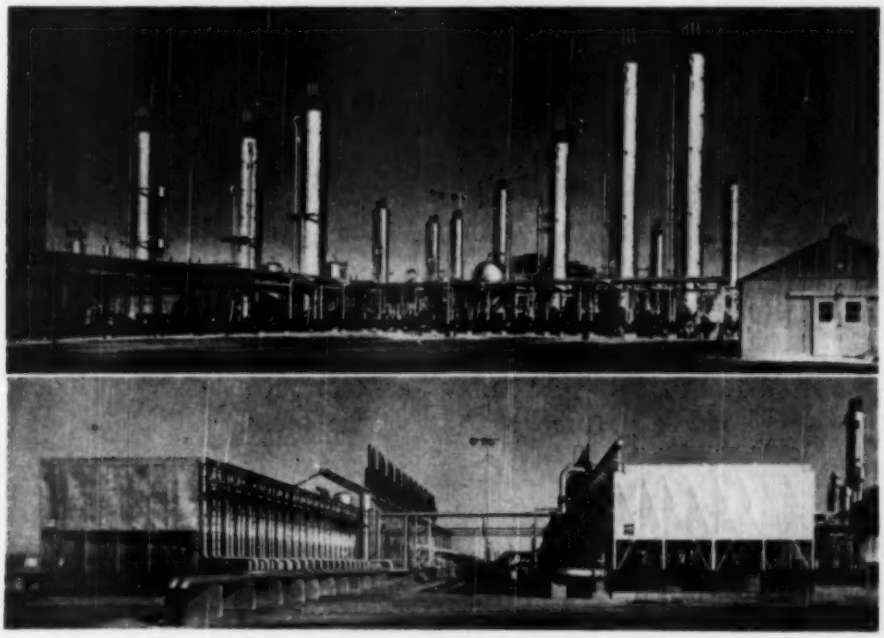
Top, below—A complete distillation unit and additional absorption capacity were added to the TXL plant. New vessels in the foreground are the absorber, high pressure still, low pressure still, deethanizer, depropanizer, and debutanizer. Existing vessels are in the background.

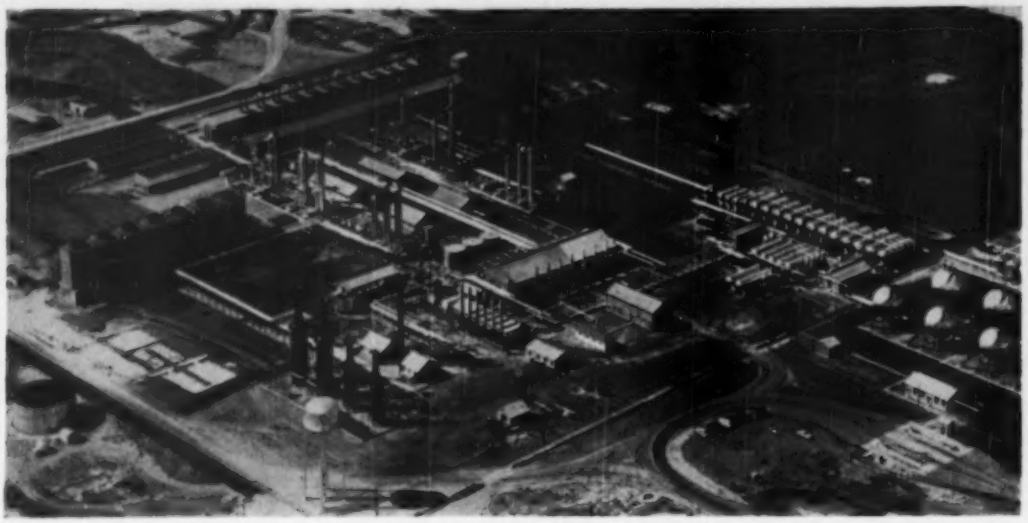
Bottom, below—Compressor engine jacket water is cooled in these air-type coolers. The new unit is in the left foreground. The new compressor building is in the left background.

SHELL Oil Company, and The Texas Company have recently completed construction of additional facilities to increase the capacity of the TXL gasoline plant near Odessa in West Texas to 90 million cubic feet daily of gas. Recovery of propane was increased to about 70 percent. The plant, operated by Shell, processes gas from wells in the surrounding TXL and Wheeler fields. Operation of the original plant began in 1948 as part of the conservation program of the two companies.

New equipment added to the plant, which originally produced a 26-pound vapor pressure natural gasoline, and a 90-pound vapor pressure liquefied petroleum gas and excess propane, includes a complete distillation section. Also added were eleven new compressors, a cooling tower, two boilers, three electric generators, air-cooling units, two rich oil heaters and two heat medium heaters. Product storage was also increased.

The vessels added are an absorber, high-pressure still, low-pressure still,



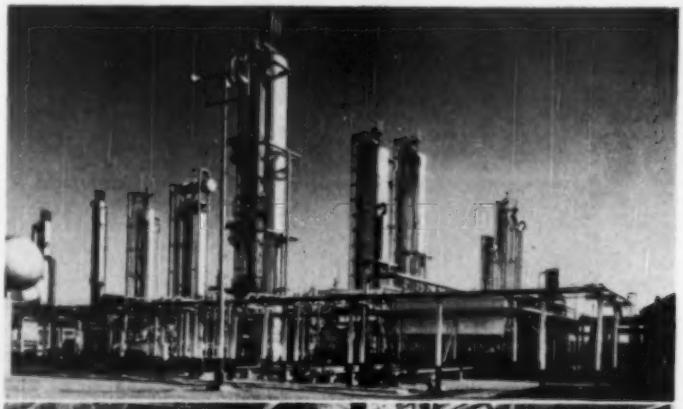


Aerial view of the TXL gasoline plant near Odessa in West Texas. The plant is owned jointly by Shell Oil Company and The Texas Company with operation by Shell. New process equipment added to the plant increased the capacity from 30 million cubic feet daily of gas to 90 million. Propane recovery is now about 70 percent.

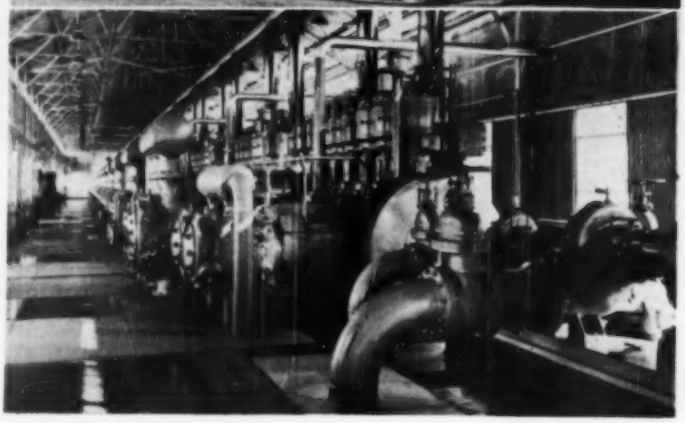
deethanizer, depropanizer, and debutanizer. Absorption pressure of the plant is 200 pounds. An increase in the steam supply required two boilers delivering 20,000 pounds per hour of steam at 250 psig., operating in conjunction with the four existing boilers. Three alternating current generators, each 665 kva., driven by eight-cylinder 760 horsepower gas engines were added to the four in service. The two heat medium heaters supply heat to the depropanizer and debutanizer.

Due to the semi-arid location of the plant, the large air-cooling units are used to supplement water cooling, and serve the compressor engines jacket water, and the overhead product streams on the high-pressure and low-pressure stills.

Construction of the plant, which was under the supervision of Shell's gas engineering section, was by Brown & Root, Inc., of Houston.



Top, right—New process area. The absorber of the new unit is in the foreground. The small accumulators on the left side of the column permit withdrawal of the absorption oil for cooling. The cooled oil is returned through the split headers on the right side of the column, which is nine feet in diameter and is equipped with double trays.



Bottom, right—Eleven new compressors were added to the plant. Two of the engine jacket cooling water pumps driven through a common shaft are in the foreground. The compressors are driven by 800 horsepower, angle-type engines. Gas is compressed in two stages to 200 pounds.

Propylene, a Valuable Feed Stock for Alkylation

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Cities Service Refinery Corporation, Lake Charles, La.

***ALKYLATES** produced in refinery alkylation processes have high octane numbers, lead susceptabilities and heat values and boil in the gasoline range to rank among the most important components of aviation and motor gasolines. The reaction most widely used in the process has been the combination of isobutane and butylene—a process of extreme importance that was used during the war to the very limit of the available feed stock.*

Additional research and development work is responsible for an extension of the original refinery alkylation process — operation on isobutane and propylene feed stock —that has been used with outstanding success in commercial production for the past several years. The data herein are from the operation of a sulfuric acid alkylation unit, on propylene, and shows the effect of the major operating variables on aviation alkylate quality, alkylate yield and acid consumption. The authors present in detail a discussion on the process, major maintenance problems, and design of equipment.

THE alkylation of isobutane with propylene, using sulfuric acid as a catalyst, is no longer an investigation in the pilot plant stages but is a proven commercially feasible operation as exemplified by the fact that the Cities Service Tutwiler refinery, Lake Charles, La., carried out this operation for more than four years. During this period as much as 2700 barrels per stream day of propylene has been alkylated. The initial stages of this operation have been described elsewhere,[4] but propylene has proved to be such a valuable alkylation feed stock that additional propylene alkylation capacity has been made available by restoring to operation a large part of a wartime pentene alkylation unit to operate in conjunction with a butylene alkylation unit previously modified to handle propylene.

Due to increased crude level, catalytic cracking unit throughput and, consequently, increased production and recovery of propylene over the past two years, alkylation unit capacity limited propylene alkylate production during the summer months and during any period when major unit equipment was removed from service for maintenance and repair. There is no storage available for the propane-propylene stream produced at the catalytic fractionation unit, making it necessary to alkylate propylene on a continuous basis or burn this material as fuel gas since there is no other equipment for processing this valuable hydrocarbon in the refinery at present. For these reasons, additional alkylation capacity for handling approximately 1500 bpsd. of propylene or 2000 bpsd. of butylene was made available by utilization of equipment in the pentene alkylation unit. This equipment was connected in such a manner as to permit the removal of almost any major piece of equipment from service without materially reducing the propylene alkylate production capacity.

Originally the old pentene alkylation unit was designed to produce 8400 bpsd. of aviation alkylate. The unit was originally composed of five reactor-settlers, five refrigeration compressors, a debutanizer, a rerun tower and other minor equipment. During the period that this unit was out of service, two compressors were put into plant air service and two of the four cylinders of one compressor were modified to handle propane gas. When this unit was reactivated, the other two compressors and the revamped compressor, three reactor-settlers, the debutanizer, rerun tower and other minor equipment were put into service. In

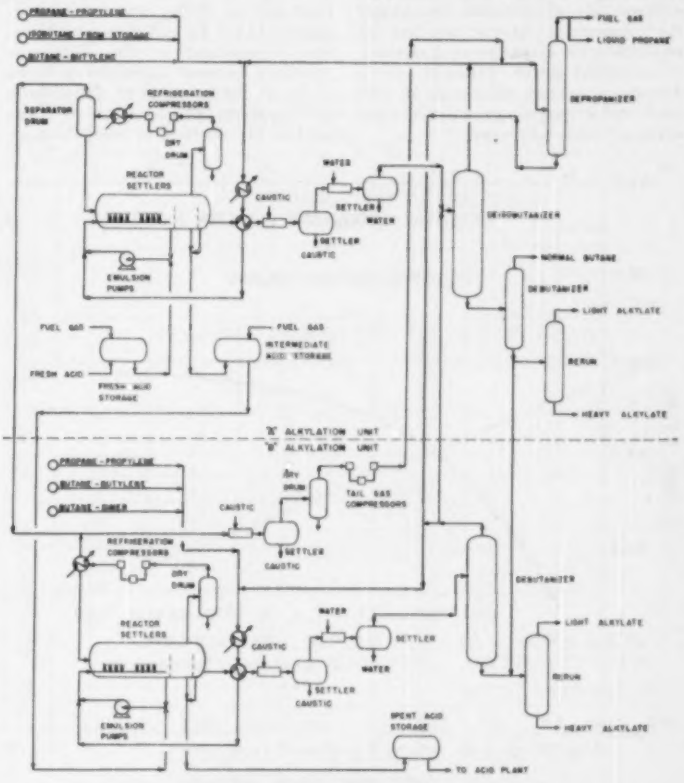

Figure 1. Simplified Flow Sheet of a Typical Alkylation Operation.

order to alkylate propylene in this unit it was necessary to tie into the propane handling system of the other unit.

Soon after the reactivation of the pentene unit equipment, tests were conducted which showed that the spent acid from the butylene alkylation unit, ranging between 91 to 93 weight percent H_2SO_4, could be used as acid charge to the revamped unit reactor-settlers and further consumed to 87 to 89 weight percent H_2SO_4 with no apparent decrease in quality of the alkylate produced, as was previously predicted.[6] As propylene recovery increased, additional butylene became available for alkylation feed, which permitted the over-all alkylate production to be increased to approximately 9000 bpd. At this high production rate (approximately 50 percent propylene alkylate) it was essential that the spent acid concentration be maintained at approximately 87 to 89 weight percent H_2SO_4 in order to stay within the limit of the acid plant regeneration capacity.

The alkylation equipment is physically located in two separate units and it is comprised of two reactor-settler sections, two refrigeration systems and the conventional towers required for separating the major product streams. A simplified sketch, Figure 1, shows the major process equipment of both units and a typical operation of these units as discussed below.

The revamped butylene and pentene units are referred to as the "A" and "B" alkylation units, respectively, in Figure 1 and the remainder of this discussion.

The propane-propylene feed stream is pumped from the catalytic fractionation unit through the Girbotol unit, where hydrogen sulfide is removed, and into the reactor-settler hydrocarbon feed line of each unit where it joins the other fresh feed and recycle streams enroute to the reactor-settlers. The entire streams to each unit have an isobutane to olefin ratio of approximately 6:1, called external ratio. They are cooled by water and by the reactor-settler effluent to approximately 80° F. prior to being divided into equal streams and charged into the seven 45-foot (long) x 10-foot (diameter) horizontal reactor-settlers together with hydrocarbon acid emulsion. The hydrocarbons and acid are thoroughly mixed by the two 100,000 barrels per day emulsion circulation pumps of each reactor-settler and discharged through pyrex jets spaced evenly along the emulsion discharge headers below the emulsion level. At this point the isobutane to olefin ratio is approximately 115:1 (internal ratio). Alkylate is produced by the exothermic reactions between isobutane and the olefin in the presence of the sulfuric acid catalyst. The concentration of the acid in the reaction or emulsion zone is maintained at 90 to 93 percent in the "A" unit and 86 to 89 percent in the "B" unit, and the emulsion is approximately one volume of acid to one volume of hydrocarbon. The acid concentration is controlled by varying the quantity of 98 percent white sulfuric acid makeup to the "A" unit.

The temperature in the reactor-settlers is maintained between 45 and 75° F. (depending on the feed composition and production level) by auto-refrigeration systems. The hydrocarbons in the reactor-settlers are allowed to vaporize at their vapor pressure of 20 to 30 psig. The vapor, rich in propane and isobutane, leaves the top of the reactor-settlers, passes through the compressor dry drums where entrained liquid is removed, then to the seven 600-hp. compressors where it is compressed to about 100 psig. prior to entering the refrigeration condensers. Here as much material is condensed as possible (mostly C_4's) with river water, at a maximum condensate temperature of approximately 100° F. In the "A" unit, condensate and vapor flow to the separator drum where the condensate is drawn off the bottom and returned to the reactor-settlers as refrigerant. In the "B" unit, the vapor is drawn from the top of the condensers. The vapor, largely propane, is contacted with caustic after leaving the drum and then flows through a caustic settler and into a high pressure dry drum. The essentially dry vapor off the dry drum is compressed by the tail gas compressors which discharge into the depropanizer tower for recovery of butanes.

The seven reactor-settler vessels are each divided into three sections: a) reaction or emulsion section, b) acid settling section, and c) final settling section to provide holding time for the effluent hydrocarbon stream. Partial settling of the hydrocarbons and acid takes place in the upper layer of the reaction zone, and this mixture flows over a weir into the acid settling section. Here the spent acid equivalent to the quantity of acid makeup is separated and withdrawn to acid storage. The hydrocarbons from the settling section flow over a second weir into the final drawoff section which provides final acid settling and surge capacity for the essentially acid free reactor-settler product. The spent acid from "A" unit goes to intermediate storage for subsequent use as acid charge to the "B" unit reactor-settlers. Spent acid from "B" unit goes to storage prior to being pumped to the acid plant for regeneration.

The reactor-settler product is pumped through the reactor feed-product exchanger, caustic mixer and settler,

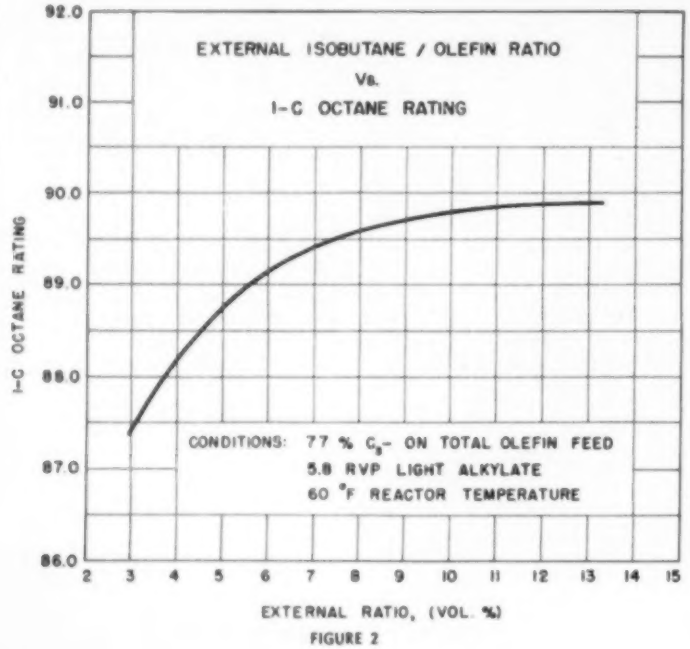

FIGURE 2

water-mixer and settler, to the deisobutanizer tower in the "A" unit or the debutanizer in the "B" unit. The last traces of any free acid carryover are neutralized and removed in the caustic and water wash equipment.

The hydrocarbon stream from the "B" unit water settler is charged to the debutanizer where a separation is made between butanes and total alkylate. The stream containing butanes and lighter is divided, a part is charged to the reactors as recycle and the balance to the "A" unit isobutane tower. The total alkylate is charged to the "B" rerun tower.

The hydrocarbon stream from the "A" unit water settler is joined by a part of the "B" unit debutanizer overhead stream and is charged to the deisobutanizer tower in "A" unit. In this tower a mixture consisting of propane, isobutane, and normal butane, containing approximately 83 percent isobutane, is taken overhead; and the remainder, butanes and alkylate, is removed in the product leaving the bottom of the tower.

Part of the overhead product from the 50-tray deisobutanizer tower is recycled to the reactor-settlers; the remainder is joined by the compressed vapor stream discharged from the tail gas compressors and is charged to the 28-tray depropanizer tower. In this tower, propane, equal in amount to that in the feed streams to the unit, is removed as overhead product. The overhead product is either utilized in processing or is burned in the fuel gas system. The depropanizer bottom product, containing approximately 85 percent isobutane, is either recycled back to the reactor-settlers to maintain proper isobutane to olefin ratio or sent to storage. The product from the bottom of the deisobutanizer tower is charged to the debutanizer tower where essentially complete separation bebutanes and alkylate is obtained. The debutanizer is a 24-tray tower and is normally operated to produce a specified RVP alkylate product. A portion of the total alkylate from the bottom of the "A" unit debutanizer is charged to the 16-tray "A" unit rerun tower; the remainder is charged to the 16-tray "B" unit rerun tower along with the "B" unit total alkylate. In these towers the total alkylate is fractionated into an overhead product comprising approximately 95 percent of the total alkylate charge, called light alkylate, and a bottom product comprising approximately 5 percent of the total alkylate charged, referred to as heavy alkylate. Heavy alkylate is used for pump gland oil makeup.

Design: The conventional refinery equipment used for butylene and pentene alkylation employing sulfuric acid catalyst, with additional propane processing equipment, in general is satisfactory for propylene alkylation. Carbon steel is satisfactory in almost all installations; all towers and vessels are of welded construction and the high-pressure vessels are stress relieved. The jets in the reactor-settlers are made of pyrex glass which are often broken. Tests have been made with alloy jets which have proved satisfactory. The piping system is of flanged and welded steel construction. Most pump cases are made of cast steel with the moving parts of alloy. The tube bundles in the condensers and coolers have admiralty brass tubes and the reboilers have steel tubes.

Substantially conventional equipment is used for instrumentation; orifice type flow meters are used in metering all streams except acid flow where rotameter type instruments have proved more satisfactory. Internal floats were initially used due to the shortage of metal during the war, but these have largely been replaced by outside floats which have given better service.

Pumps being used for hydrocarbons, caustic and acid-oil mixtures are mostly of conventional centrifugal de-

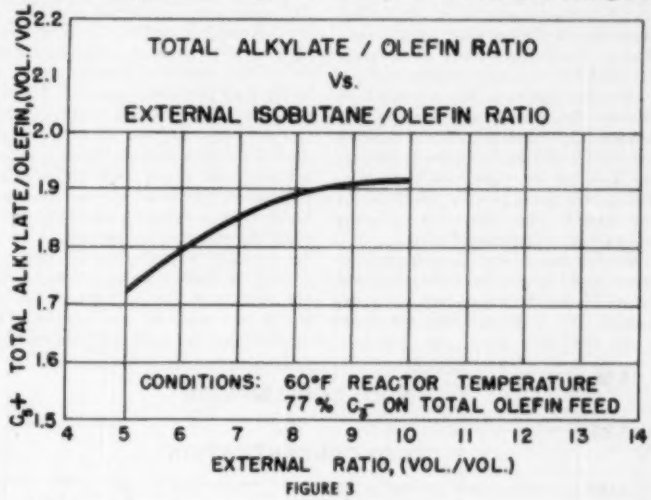

FIGURE 3

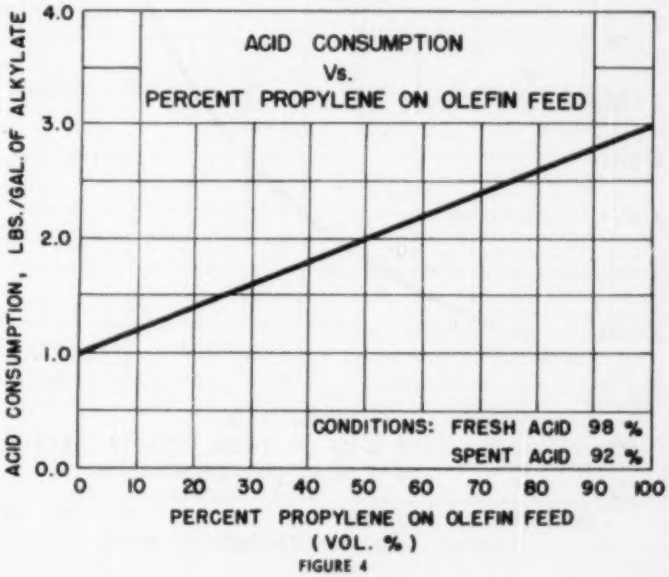

FIGURE 4

sign and are driven by steam turbines. Reciprocating pumps and natural gas pressured vessels are used for moving acid. Originally the centrifugal pumps were equipped with double Duraseal type seals, cooled and lubricated with a light motor oil, or the conventional soft packing, cooled and lubricated with a heavy alkylate gland oil. However, a carbon ring single seal has proved more satisfactory in almost every service, and the installation of this seal on all centrifugal pumps except the depropanizer reflux pumps is planned. Refrigeration compression is supplied by six 600-hp., 300 rpm., right-angle, reciprocating, gas-engine-driven compressors. For the initial stages of alkylation with propylene a 225-hp. gas-engine-driven compressor was used for charging reactor tail gas to the depropanizer for recovery of butane. As propylene recovery increased it became necessary to increase the reactor tail gas compressor capacity. Two of the four cylinders of a 600-hp. compressor were modified for this service. The other two cylinders are used in refrigeration service.

Maintenance: The largest maintenance problem has been cleaning and repair of the thermo-siphon steam reboilers. The hydrocarbons introduced to the shell side of the reboilers contain hydrocarbon esters that decompose at increased temperatures and liberate sulfuric acid which corrodes the outside of the steel tubes. A tar-like polymer deposit forms on the outside surface of the tubes which has to be removed at intervals. During the past year the introduction of a weak caustic solution containing phenols along with steam at the bottom of the reboilers has apparently reduced reboiler fouling and corrosion. Little difficulty has been experienced with corrosion or fouling of the wall or internals of the towers.

Perhaps the second largest maintenance item has been the compressors. The principal trouble has been due to the discharge valves fouling and occasionally breaking. Analyses have shown the presence of sulfur dioxide in the feed to the compressors, but the presence of entrained sulfuric acid has not been detected. In order to reduce the sulfur dioxide going into the refinery fuel gas system with the depropanizer overhead stream, the reactor tail gas is caustic washed upstream from the tail gas compressors. Due to the inability to complete the installation of the caustic wash system in time for startup of the compressor, an attempt was made to use ammonia for neutralizing the gaseous hydrocarbons going to the compressors. This caused a white precipitate to deposit in the tail gas compressor cylinders, and almost an immediate shutdown of the compressor was necessary.

For a period after alkylate production was increased, considerable difficulty was experienced with failure of certain lines throughout the units. This was believed to be due to the high velocity caused by operating at flow rates which were at times twice design capacity. Most of these lines have been replaced with larger sizes and very little difficulty is now experienced.

The installation of connecting lines between the two alkylation units in the past two years has made it possible to remove any one tower from service except the depropanizer without reducing propylene alkylation. Recently, a line installed from the discharge of the reactor tail gas compressors to the straight-run fractionation unit depropanizer has allowed the alkylation unit depropanizer to be spared for repair. While the over-all alkylation capacity and fractionation efficiency may be reduced by the removal of a tower from service, all available propylene can be alkylated. There is sufficient butylene storage in the refinery and alkylation capacity to allow butylene to be stored for short periods. Also, there is sufficient reactor-settler and refrigeration-compressor capacity to allow the shutdown of a single reactor or compressor without loss of alkylation capacity. However, the shutdown of the tail gas compressor system will cause almost immediate loss of most of the propylene to the fuel gas system.

The octane rating of the light alkylate fraction, usually utilized as an aviation gasoline base stock, and acid consumption, which represents a major operating cost, are the two most important factors in the alkylation of isobutane with propylene and butylene. There are many process variables which affect these two major economic factors and those most often considered are: a) external and internal ratio, b) concentration of propylene in the olefin feed, c) catalyst concentration, d) reactor-settler temperature, e) contact time, f) ratio of acid to hydrocarbon, and g) diluents in the feed.

The correlations presented herein were based entirely on commercial unit daily control samples. These correlations and others presented elsewhere have been recently reviewed in light of present operation with two units operating with hydrocarbon feeds in parallel and acid in series flow in contrast with previous single unit operation at lower propylene feed rates.

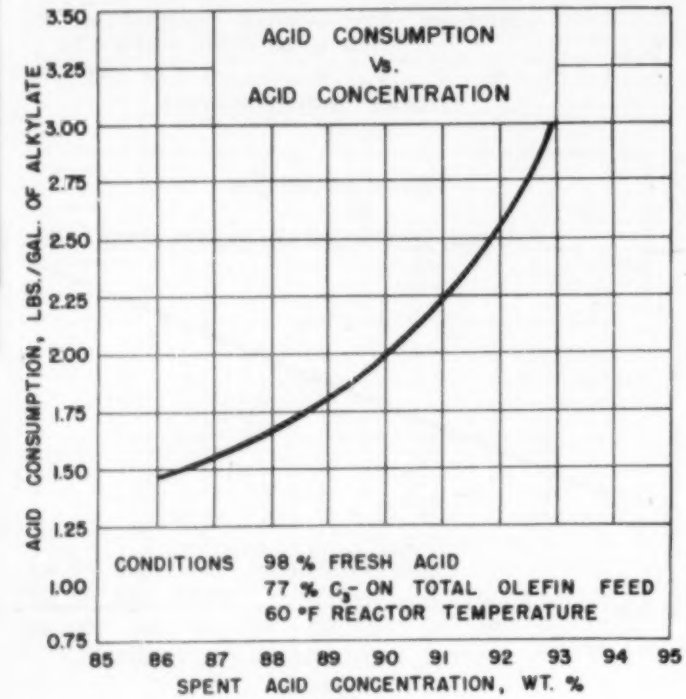

FIGURE 5

The study of process variables has been somewhat hampered by the dual unit operation which is regarded as one large unit in some phases of accounting. However, recent data studied not only substantiated previous work but in some cases permitted extension of curves beyond limits of the data for single unit operation. It should be noted that the major operating variables under which the following correlations are given are shown on the graphs. These conditions were chosen due to their being near average, for an extended period.

External and Internal Ratio: External ratio, which is the ratio of isobutane in the fresh feed to the reactor-settlers divided by the amount of olefin in the fresh feed, is shown plotted versus 1-C octane rating of the light alkylate product in Figure 2. Changes in octane rating for operation below 6.0:1 external ratio are quite effective, whereas above ratios of 9.0:1 the incremental improvement in octane rating decreases rapidly. Internal ratio, which is the ratio of isobutane to olefin in the fresh feed plus the hydrocarbon-acid emulsion, is equivalent to approximately 115:1 (at 6.0:1 external ratio) for average operation and maximum emulsion recycle.

The external isobutane to olefin ratio affects the total alkylate to olefin ratio as shown in Figure 3. These data, based on average operating conditions, indicate a general increase in alkylate yield with an increase in the external isobutane to olefin ratio. The trend of this curve is in close agreement with pilot plant predictions and work by Skinner[7] on butylene alkylation using hydrofluoric acid catalyst. The data on this curve are useful in maintaining the best feed balance of isobutane and olefin depending upon availability of each.

Concentration of Propylene in Olefin Feed: The concentration of propylene in olefin feed has a considerable effect on both the acid consumption and the quality of the light alkylate product. The relationship between acid consumption, expressed in pounds of acid per gallon of true alkylate (C_5 plus material produced), and percent propylene on olefin feed is shown in Figure 4. The acid consumption for propylene is approximately three times that of butylene.

Acid Concentration: The concentration of the fresh sulfuric acid charged to the reactor-settlers averages 98 percent while the concentration of the spent or reject acid to the acid plant varies between 86 and 92 percent. Figure 5 shows the relationship between spent acid concentration and acid consumption. Most of the data used for this correlation were above 87 percent spent acid concentration. As a large percentage of the cost of producing alkylate is the cost of sulfuric acid, it is important to keep acid consumption as low as possible. It is believed that this curve will show a break when the polymerization point is reached; however, this has not been firmly established in this refinery. Considerable data were studied to show the effect of catalyst concentration on quality of propylene alkylate produced, and these data show no effect on quality for catalyst concentration from 87 to 94 percent H_2SO_4 under average operating conditions.

Reactor-Settler Temperature: Normally the reactor-settler temperature is maintained as low as possible with the available refrigeration capacity. Figure 6 shows the relationship between the 1-C octane rating of the light alkylate and the reactor-settler temperature. This temperature usually varies between 45 and 75° F, depending on cooling water temperature, equip-

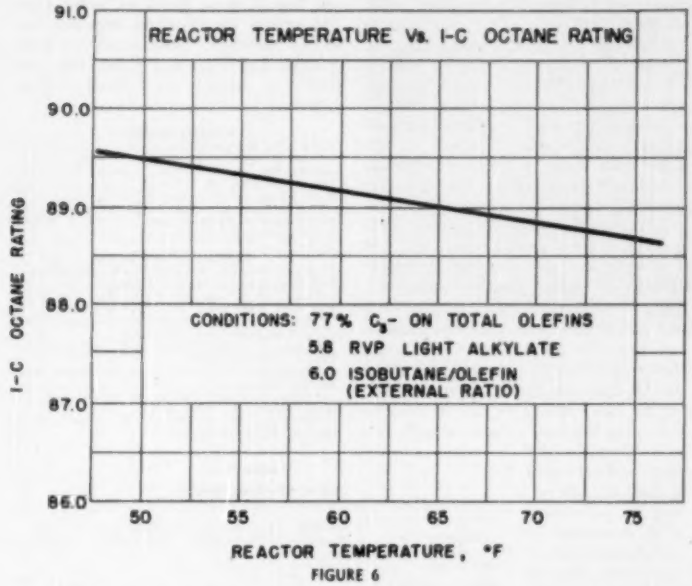

FIGURE 6

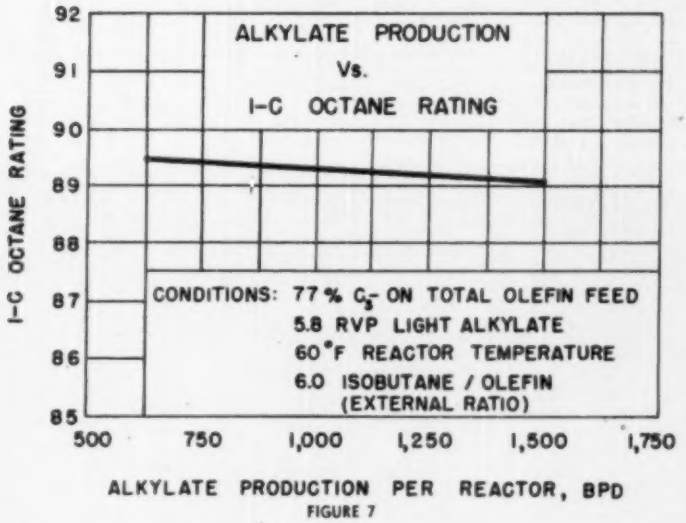

FIGURE 7

ment condition and alkylate production. In this range, no effect of temperature on acid consumption has been detected. However, work has been reported with temperatures as high as 100° F., showing good yields.[2]

Contact Time: Contact time (hold-up time in the emulsion section) generally ranges from 20 to 35 minutes and is a direct function of production rate under normal conditions. This contact time is within the range of that used in other commercial units.[1] Figure 7 shows the relationship existing between the 1-C rating of light alkylate and the alkylate production rate per reactor. Pilot plant data substantiate this curve which shows that the quality of the light alkylate decreases as the production rate increases while holding the emulsion recycle rate constant.

Ratio of Acid to Hydrocarbon: Inasmuch as the reactor-settlers used in the commercial unit, upon which these data were based, were designed for an acid to hydrocarbon volume ratio of 1:1, no effort was made to study the effects of this variable. Operations at 1:1 ratio gave no operating difficulties as to acid carryover, and the ratio was sufficiently high to yield a good quality alkylate comparable with the alkylate obtained experimentally and presented by Linn and Grosse[4] for HF alkylation of isobutane with propylene.

Diluents in Feed Streams: The percentage of diluents in the feed, excepting propane and normal butane, was very small. Both of these have the effect of decreasing the isobutane to olefin contact, and propane results in increasing the vapor pressure and therefore reactor temperature, which substantiates previous work by Kniel.[3] Other diluents such as methane, ethane, ethylene, hydrogen sulfide, and mercaptans are usually present in small quantities and are undesirable. Ethylene forms a harmful ester which increases acid consumption[5] and decomposes on heating in the reboilers. The sulfur compounds consume acid.

The quality of the light alkylate product is largely dependent upon the type of olefin feed stock when the process variables are held constant. The approximate compositions of the feed streams to the reactor-settlers are shown in Table 1. This product is usually evaluated by its distillation, Reid vapor pressure and various octane ratings dependent upon its ultimate disposal. Since the quantity of propylene available for alkylation in this refinery is relatively constant, the quality of the composite alkylate increases with the quantity of butylene charged to the alkylation units which in turn is partially dependent upon the demand for aviation gasoline. Dimer or di-isobutylene as an olefin feed stock has proved to be equivalent to butylene as far as alkylate quality was concerned. Table 2 is presented in order to show the differences in quality of propylene and butylene light alkylate products with varying percentages of these two olefins. Since the RVP of C_5 free propylene alkylate is approximately 0.5 unit higher than for butylene alkylate, the initial and 10 percent points for propylene alkylate product as shown in Table 2 are higher at constant RVP. Due to its low 50 percent point, propylene alkylate product is usually considered a better motor gasoline blending stock than butylene alkylate even though its ASTM octane rating is slightly lower. Due to its higher aviation octane ratings, butylene alkylate is obviously preferred for high quality aviation gasoline. For these reasons it is sometimes advantageous to produce alkylates of different quality simultaneously on the two units. This can be done by adjusting the feed streams to each unit.

Although the data indicate that a higher percentage of pentanes and hexanes is produced by alkylation of isobutane with propylene than with butylene, no attempt was made to explain this phenomena.

It is generally believed that the catalyst concentration affects the quality of butylene alkylate; therefore, the data presented in Table 2 were taken at constant catalyst concentration. It should be noted that the considerable data reviewed for this study show no effect on the quality of propylene alkylate for changes in acid concentration between 87 and 94 weight percent H_2SO_4 at average operating conditions.

The heavy alkylate fraction which usually varies from 3 to 7 percent based on the total alkylate feed to the rerun tower is undesirable for blending into aviation gasoline. This material has a boiling range of 340° initial to approximately 540° ASTM end point. The octane rating of heavy alkylate is lower than that of light alkylate, but it is as good or better than the octane specification required for motor gasoline. Because of its gum content and high end point, this material is usually redistilled before blending to motor gasoline.

ACKNOWLEDGMENT

We wish to express our appreciation to Cities Service Refining Corporation for permission to publish this paper and to recognize the splendid cooperation of Messrs. J. L. Sperry and N. N. Feller of the operating department.

The authors gratefully acknowledge the indispensable assistance given by C. E. Smith in preparing the graphs.

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[6] Odeu, E. C. and Burch, W. J., Jr. Ind. and Eng. Chem., **41**, 2284 (1949).
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TABLE 2

Light Alkylate Quality

OLEFIN	95–100% Propylene	77% Propylene 23% Butylene	50% Propylene 50% Butylene	100% Butylene
Gravity, °API	73.7	73.4	73.0	72.4
ASTM Distillation:				
IBP	118	115	114	110
10 Percent	163	162	161	158
20 Percent	186	188	189	192
30 Percent	195	199	205	214
70 Percent	205	211	218	230
90 Percent	246	250	251	256
End Point	340	340	340	340
Percent Loss	1.0	1.0	1.0	1.0
Percent Recovery	98.5	98.5	98.5	98.5
RVP	5.8	5.8	5.8	5.8
Octanes:				
ASTM (MM) Clear[1]	88.2	88.8	89.5	91.0
F-3 Clear	88.2	89.1	90.0	91.8
F-3 + 4 cc. TEL	102.2	102.8	103.6	105.0
F-4 + 4 cc. TEL[1]	8+1.2	8+1.8	8+2.0	8+2.8

Conditions:
80° F. Reactor Temperature.
5.8 RVP.
6.0 Isobutane Olefin External Ratio (Volume/Volume).
91-93 Weight Percent Spent Acid.

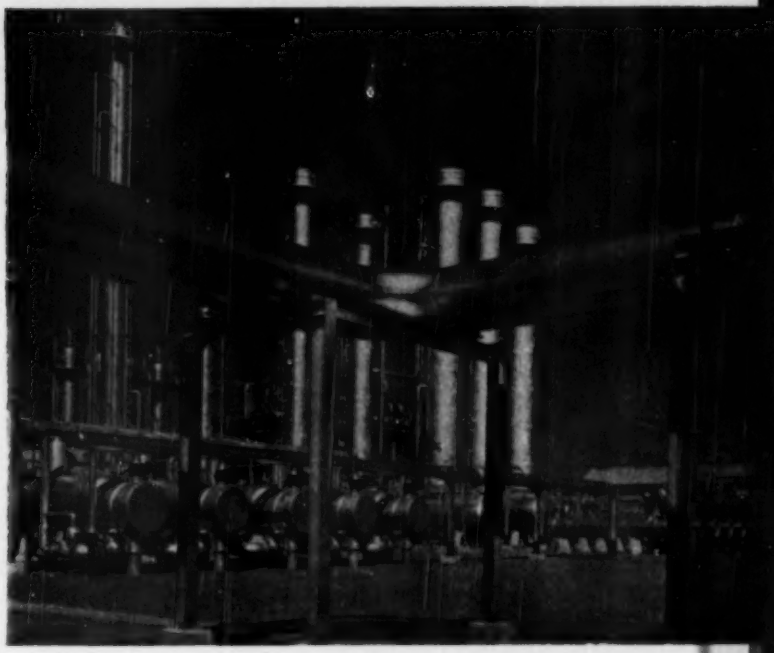
[1] Limited data.

TABLE 1

Typical Reactor-Settler Feed Stream Analysis

STREAM	ANALYSIS, LIQUID VOLUME, PERCENT										
	CH_4	C_2H_6	C_3H_6	C_3H_8	C_4H_8	IC_4H_8	IC_4H_{10}	NC_4H_8	NC_4H_{10}	C_5H_{12}	Dimer
Propane-Propylene	0.3	1.9	5.0	30.0	35.0	2.0	5.9	0.5	0.2	0.0	0.0
Butane-Butylene	0.0	0.0	0.0	0.7	1.8	16.5	38.1	30.4	11.9	0.6	0.0
Deisobutanizer O.H.	0.0	0.0	0.0	0.0	11.6	0.0	78.5	0.0	9.9	0.0	0.0
Depropanizer Btms.	0.0	0.0	0.0	0.0	5.0	0.0	84.8	0.3	9.3	0.6	0.0
Isobutane from Storage	0.0	0.0	0.0	2.4	3.9	0.0	76.2	0.3	16.8	0.4	0.0
Butane-Dimer	0.0	0.0	0.0	0.9	2.4	2.0	51.0	4.9	16.0	0.8	22.0
"B" Unit Debutanizer O.H.	0.0	0.0	0.0	1.0	9.0	0.0	65.0	0.2	23.8	1.0	0.0

Katy-3 Designed For High Propane Recovery

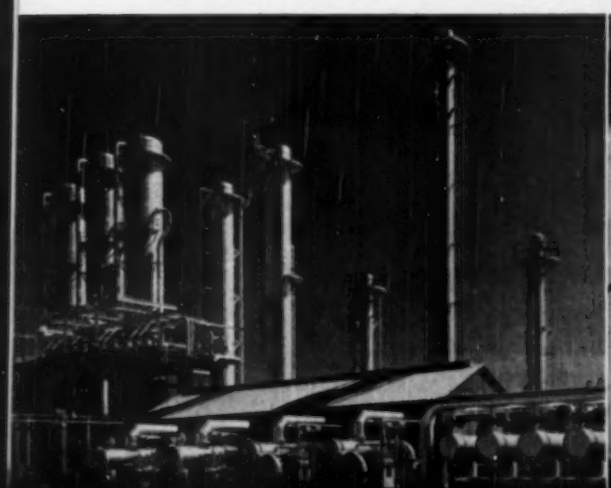


The exchangers in the left foreground, Katy gas cycling plant, are the main lean oil chillers where the oil stream is cooled by propane refrigeration to 70° F. The bank of coolers on the right of the chillers are the final lean oil coolers. Shell and tube type heat exchange equipment has been used throughout the plant.

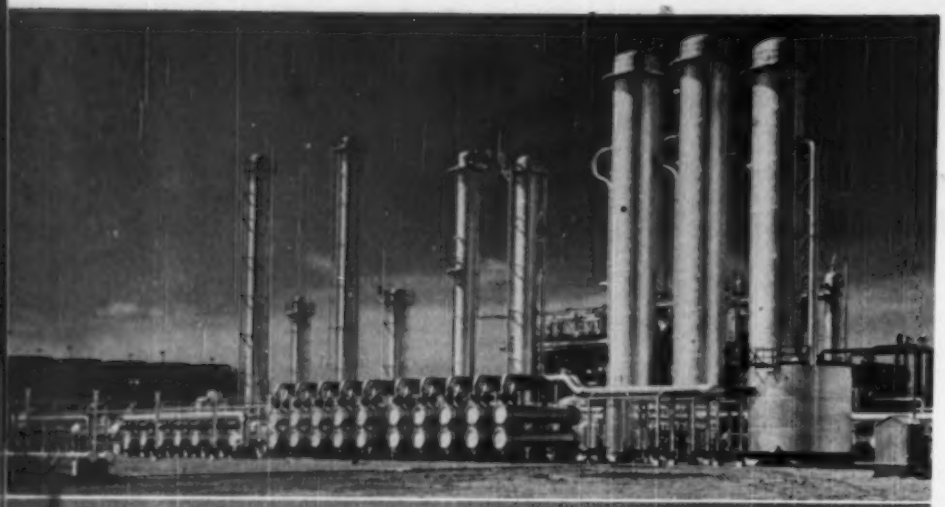
KATY-3, a new natural gas processing plant, designed and built for high recovery of propane at the Katy Gas Cycling Plant near Katy, Texas, is now on stream. According to Humble Oil & Refining Company, Katy operator, the plant is designed to process 300 million cubic feet daily of gas. Process of the plant employs high pressure absorption, 1850 psi., and a refrigeration system for chilling the high molecular weight absorption oil.

Addition of the new unit does not increase the 500 million cubic feet per day gas processing capacity of the Katy plant; however, it has increased greatly the production of propane. While the new unit contains nearly half of the absorption capacity of the entire plant, it is not equipped with product fractionation equipment, other than that required for high propane recovery. Depropanized raw material is fractionated into various products in the other units of the plant, whose absorption capacity has been reduced by the transfer of two absorbers to the new unit. Katy-1 and Katy-2 now operate with three high pressure absorbers each.

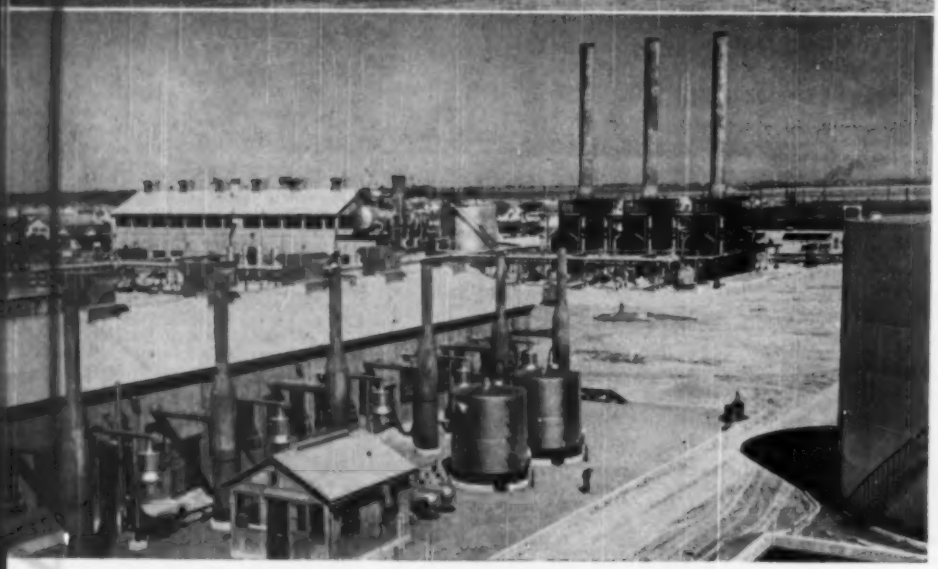
Major units of the new plant include the processing vessels, refrigeration system, compressors, boilers, generators, rich oil furnaces, and cooling tower. Presently, the plant contains five main absorbers with two transferred absorbers being installed. There are four reabsorbers operating at 800, 600, 430, and 175 psi. in the demethanizing section. The deethanizer and depropanizer are 30 and 40-tray vessels, respectively. Most outstanding vessels in the plant are the twin main stills, operated in parallel, which contain 23 trays each and are 105 feet high and 12 feet in



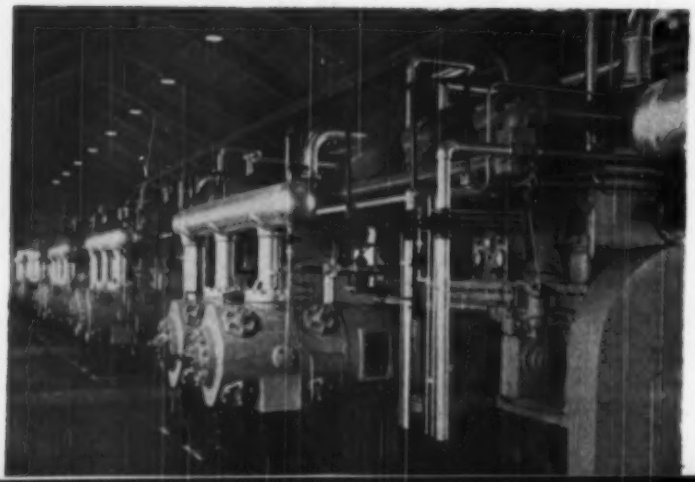
Bottom, left—Rear of building housing high-pressure lean oil pumps and refrigeration compressors showing the vacuum condensers for the steam turbines driving these units. The overhead condensers for the stills, deethanizer, and depropanizer are on the top deck of the structure at the left. Accumulators for the vessels are below the condensers on the first deck, and the pumps are housed below the accumulators. The refrigeration system condensers are in the right foreground. Bottom right—Two steam turbine driven centrifugal compressors are used for the plant refrigeration system, which has a design capacity of 2800 tons. Propane is used as a refrigerant to cool the lean absorption oil to 70° F. in addition to cooling critical gas streams.



Top, left—Processing area of the new Katy-3 unit addition to Katy gas cycling plant. Processing columns (l-r) are the 800, 600, 430, and 175-pound reabsorbers, the 40-tray depropanizer, 30-tray deethanizer, 23-tray twin main stills, and the 27-tray primary still. Height of the main stills is 105 feet, the primary still, 100 feet. Diameter of these columns is 12 feet. The heat exchangers in the center foreground are the lean oil-rich oil exchangers. At the left of these exchangers are the shell and tube coolers for the lean oil. Behind the processing columns can be seen the structure containing the overhead condensers, accumulators, and pumps for the stills, deethanizer, and depropanizer. The high pressure absorbers are behind the structure.



Center, left—Rear of the compressor building showing the exhaust silencers of five of the eleven compressors. In the left background is the new power plant consisting of four 85,000-pound-per-hour water tube boilers and two 2500-kw. generators. Three direct fired rich oil heaters, operated in parallel, are in the right background.



diameter. The primary still, 27 trays, is 100 feet high and also 12 feet in diameter. The overhead condensers, accumulators, and pumps for the deethanizer, depropanizer, and stills are located in a refinery type structure alongside the row of columns.

Engineering and construction of the new unit was by Stearns-Roger Manufacturing Company, Denver, Colo.

A view inside the compressor building showing part of the eleven 600 hp., V-type, gas engine driven compressors utilized. These units are all in recompressor service for process gas streams.

High Extraction Efficiency and Increased Capacity at Hawkins

B. J. THOMPSON
Process Engineer, Natural Gasoline Corporation

***THE HAWKINS** plant extension is a typical result of current conservation efforts of the natural gas-gasoline industry. Revision of conventional plants and processes has brought about higher extraction efficiencies and reduced operating cost. Three important factors in making revisions, of the many necessarily considered, are the plant area available for expansion, the maximum use of existing facilities, and the capital investment required.*

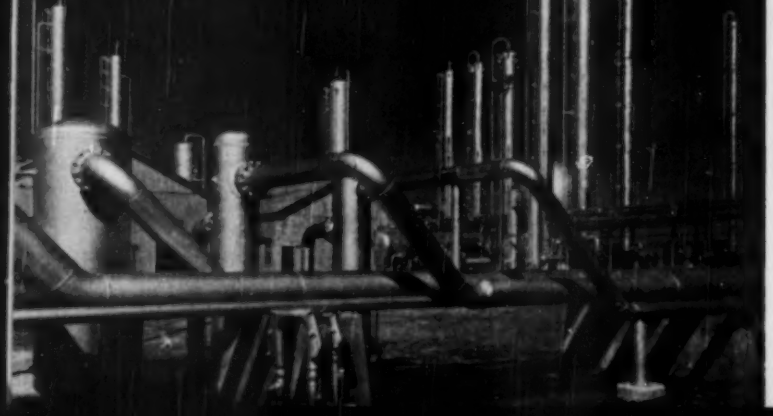
Propane extraction at Hawkins was increased from about 55 to 85 percent. Extension of the plant required absorption at 500 psig. instead of the original 200 psig., cooler lean oil by refrigeration, rich oil stabilization by use of flash and reabsorber columns, and efficient ethane-propane separation provided by refrigeration of deethanizer reflux.

A GENERAL program of conserving natural gas and jointly attaining the highest feasible extraction efficiencies in natural gasoline recovery plants has been initiated by most major gas processing plant operators during the last half decade. In keeping with general conservation of natural resources and high extraction efficiency stimulated by the expanding propane market, a revision of the Hawkins plant was initiated in 1948 and completed in 1949. The original Hawkins plant was constructed in 1944 as a conventional compression-absorption type natural gasoline and LPG recovery plant to serve the Hawkins oil field.

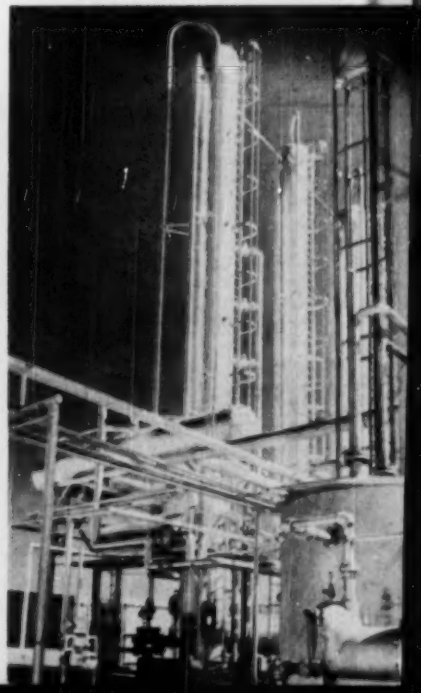
The plant is jointly owned by Humble Oil & Refining Company and Natural Gasoline Corporation. Natural Gasoline Corporation is operator of the plant which includes the gas gathering system from the leases to the plant, complete gas processing, shipment of products by tank-trucks and tank-cars and delivery at the plant fence of residue gas into the gas transmission company line.

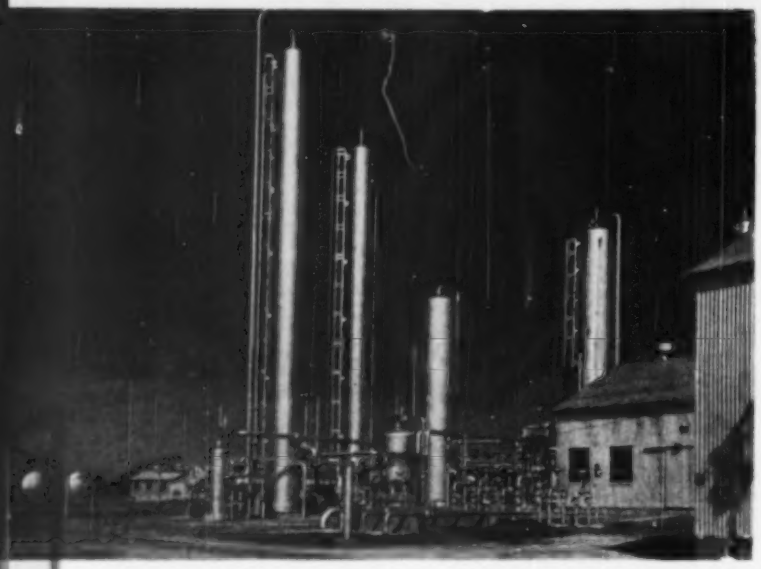
The process selected for the plant revision gave due consideration to such factors as available space for expansion within the existing plant area, maximum utilization of existing facilities in providing the higher efficiency and the capital investment required. The fundamental changes consisted of: providing total plant capacity sufficient to gather and process all flare gas from the Hawkins oil field which totaled 20 million cubic feet per day delivery of plant residue gas to gas pipe line company at approximately 500 psig.; increasing the extraction efficiency of the primary absorption facilities and the deethaniza-

The Hawkins, Texas, gasoline plant, owned jointly by Natural Gasoline Corporation and Humble Oil & Refining Company, is designed to process 20 million cubic feet daily of gas with a recovery efficiency of 85 percent propane. Columns (l-r) absorber, reabsorber, flash tower, evaporator-dephlegmator, deethanizer, depropanizer and debutanizer. The remaining four columns are used for specialty products fractionation.



Below, the column in the right center is the deethanizer, which is equipped with a chiller to provide reflux at 60-70° F. The reflux accumulator and the reflux pump are below the chiller.





Absorber, reabsorber, flash tower, and still. Rich absorption oil is chilled by the intercoolers near the base of the absorber on the right side. The chiller for the lean oil is at the rear of the absorber.

tion equipment. These improvements were made to provide recovery efficiency of 85 percent propane and to continue recovering essentially all the butanes and heavier components. The plant extracted 55 percent of the propane in the rich gas prior to this plant revision.

Major equipment requirements included 1800-hp. (three 600-hp. Angle type), gas-engine-driven compressors for the third stage of compression to provide the 500 pounds absorption pressure, a new 500-pound absorber, a new 200-pound reabsorber, additional lean oil—rich oil heat exchange units, plunger type pumps for high-pressure lean oil circulation, additional gas cooling coils for the third stage of compression, a one-cell induced draft cooling tower for final cooling of lean oil and refrigerant, a new deethanizing fractionator provided with propane refrigeration service for reflux condensing and a new 100-kw. electric power generator.

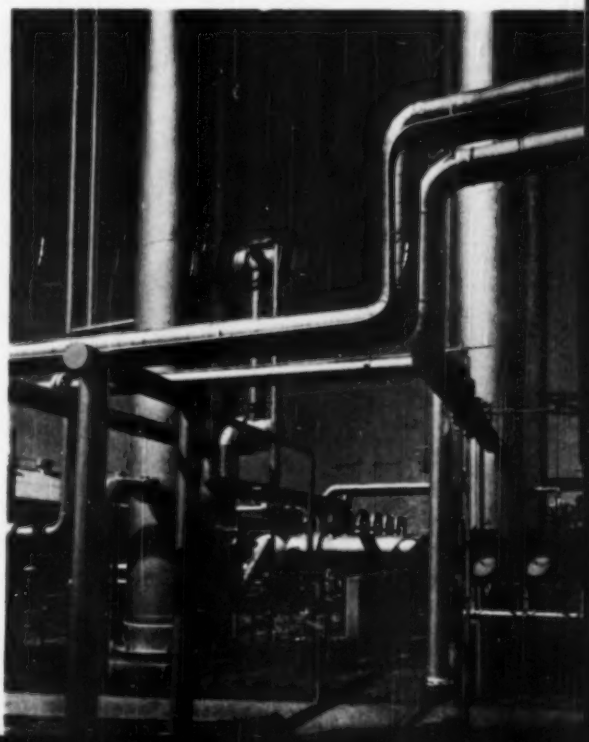
The accompanying flow diagram shows the general flow scheme for new equipment as it is used in conjunction with the original equipment.

The major factors that contribute to the higher propane extraction are 500-pound absorption (originally 200 pounds), cooler lean oil, rich oil stabilization by releasing substantial quantities of the absorbed methane and ethane overhead from the reabsorber and better ethane-propane separation as provided by the refrigerated deethanizer reflux.

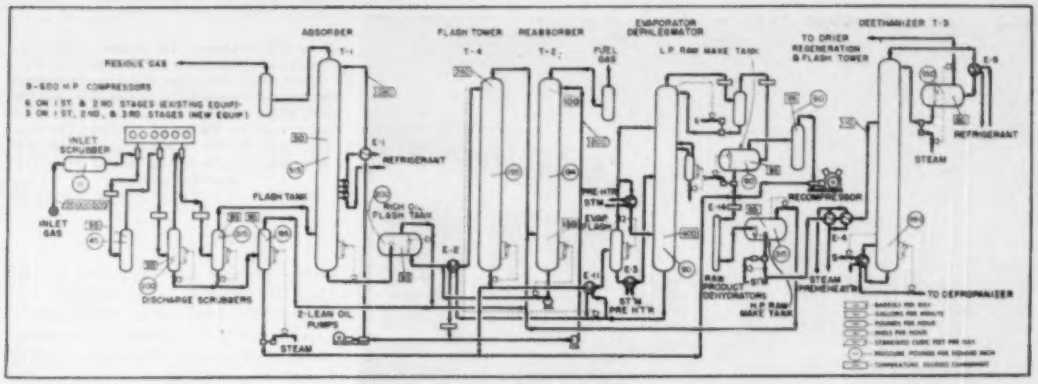
Description of Process Flow

The three 600-hp. gas-engine-driven compressor units are so installed that the low and intermediate stage compressor cylinders complement the original two stages of compression through common headers, while the third-stage 500-pound new compressor cylinders deliver gas through the coolers and thence to the 500-pound absorber T-1. The third-stage compression of rich field gas to 500-pound accomplishes two objectives, namely: increased absorption efficiency above the original 200-pound operation and supplies the residue gas pressure of approximately 350 psig. direct from the absorber into the gas purchasing company's pipe line thus eliminating the residue gas booster previously required.

The first stage compression condensate is pumped into the rich oil stream upstream from the distillation unit. The condensate from the second and third stages of compression is flashed at 185 pounds and fed either to the raw product stream or into the rich oil system. Rich oil from the primary absorber is flashed at 225 pounds and 90° F., then flows to the first bank of lean oil-rich oil heat exchangers E-2, resulting in a rich oil temperature of 200°-250° F. This heated rich oil stream is demethanized or stabilized when allowed to flash and agitation is supplied by preheated deethanizer vapors in the flash tower T-4 (original 200-pound absorber) at 180-200 pounds from which the rich oil flows through the final lean oil-rich oil heat exchangers E-11, thence



Intercoolers for the rich absorption oil are shown in the side of the absorber (left); the lean oil chiller is in the background between the two columns. Lean oil-rich oil exchangers are behind the chiller.



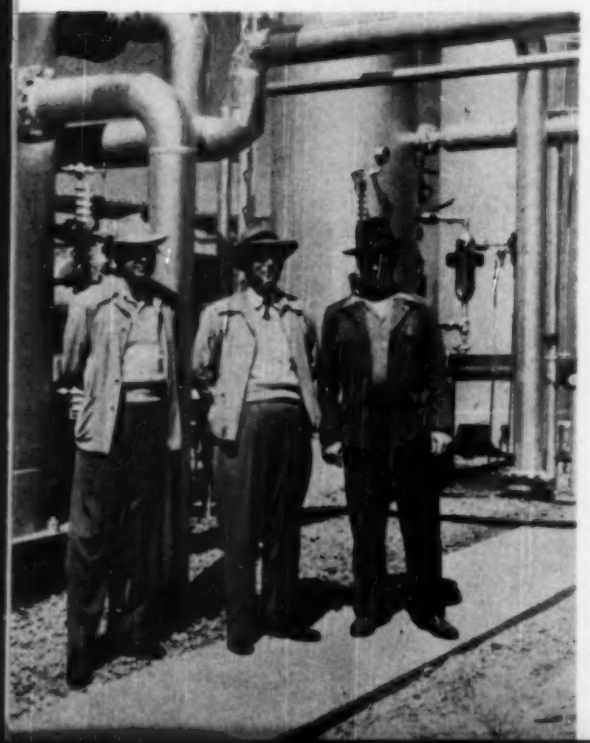
Flow Diagram of Plant at Hawkins

to a final hot flash tank from which the liquid enters the lean oil still for stripping. The vapors from the hot flash are preheated and fed to the still as stripping medium. Steam is available for final lean oil stripping in the still.

The vapor released from the rich oil flash immediately following the first bank of heat exchangers is the primary feed to the reabsorber which operates as an integral part of the rich oil flash tower or demethanizer at 180-200 pounds. Lean oil circulation or reflux to the reabsorber provides a method of controlling the extent of methane and ethane liberation and retention of propane flashed from the rich oil stream in the first part of the stabilizing operation. The enriched oil from the reabsorber is pumped into the primary absorber rich oil stream to flow through the primary bank of exchangers E-2 thus assuring a completely demethanized rich oil charge to the distillation unit through the second set of exchangers E-11. Conventional water-cooled atmospheric coils provide cooling for the still reflux and raw product primary cooling which product is delivered to a low pressure receiver V-3 operating at approximately 70 pounds. Vapors from this receiver are recompressed and coil blended with the liquid pumped from the same receiver, thence delivered through a solid desiccant type raw product dehydrator V-6 to a 300-pound raw product receiver V-4. Dehydration of the raw product is carried out at this point to prevent freezing up the deethanizer overhead condenser when using refrigeration. Provision is made for any noncondensable vapors from the 300-pound receiver to be returned to the reabsorber. Under normal operation, the raw product is totally condensed at 300 pounds.

From the 300-pound receiver or the high pressure make tank, the raw product is charged by reciprocating pump to the deethanizer at 550 pounds. The deethanizer reflux is cooled to 60°-70° F. by propane refrigeration. The heat of absorption in the primary absorber is offset by means of two propane refrigeration intercoolers located near the base of the absorber.

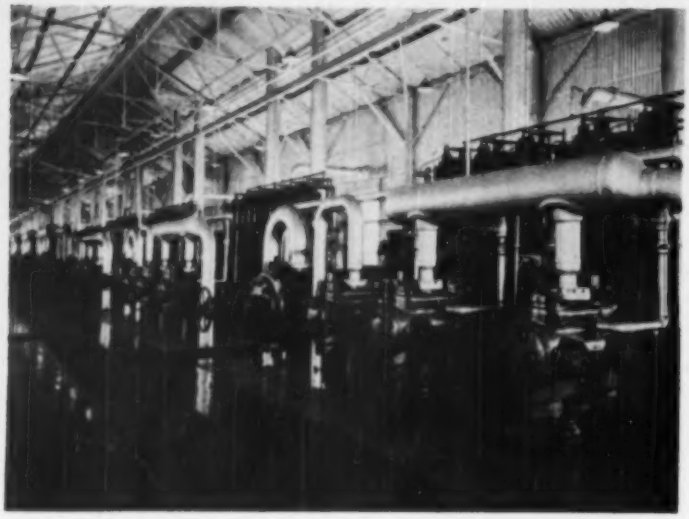
The refrigeration cycle consists of a propane surge tank from which liquid propane is fed to the deethanizer reflux shell and tube condenser and the absorber internal elements. The "spent" propane refrigerant is superheated in a lean oil chiller, the superheated propane vapors flow through a scrubber to the refrigerant compressors, the condensing coils and back to the liquid refrigerant surge tank. Exchanger unit E-1 was designed to serve the dual services of (a) chilling the main lean oil stream a few degrees below the effluent temperature from the water cooled coils and (b) to superheat the propane vapors flowing to the refrigerant compressor.



Standing in front of the absorber are H. A. Yates, plant chemist, A. S. Votaw, plant superintendent, and J. S. Berton, chief engineer.

Fractionation Plant

Ethane is distilled overhead from the deethanizer to stabilize the raw product and the base product is fed to a battery of fractionators operated on the cascade cycle. The fractionator plant is capable of producing any of



Three 600-horsepower gas engine driven compressor units installed so that the low and intermediate stage compressor cylinders complement the original two stages of compression, and the third stage cylinders deliver gas through the coolers and the 500-pound absorber. The third stage provides for increased absorption efficiency and provides residue gas for delivery at pipe line pressure.

the natural gas fractions within the natural gasoline and liquefied petroleum gas boiling range.

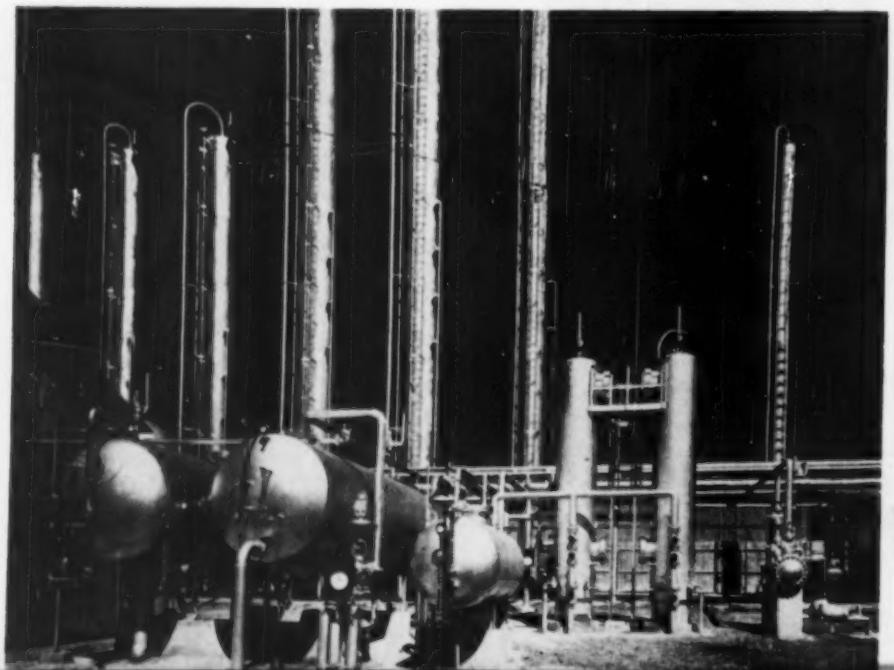
The high-pressure lean oil service is provided by a duplex piston type pump which is driven through a gear box by a vertical gas engine. An identical unit is provided for stand-by.

The final electric power demand was such that an additional 100-kw. generator unit was added, making a total of four similar units now available. One of the four units is maintained for stand-by service.

The refrigeration and recompression services are supplied by three 200-hp. horizontal-type gas-engine-driven compressor units. One unit normally serves as stand-by for the other two. A new centrifugal boiler feed pump is a popular equipment addition with boiler firemen. All residue gas flow meters and regulators were rearranged to form a neat uniform manifold system which simplifies residue distribution system operation problems.

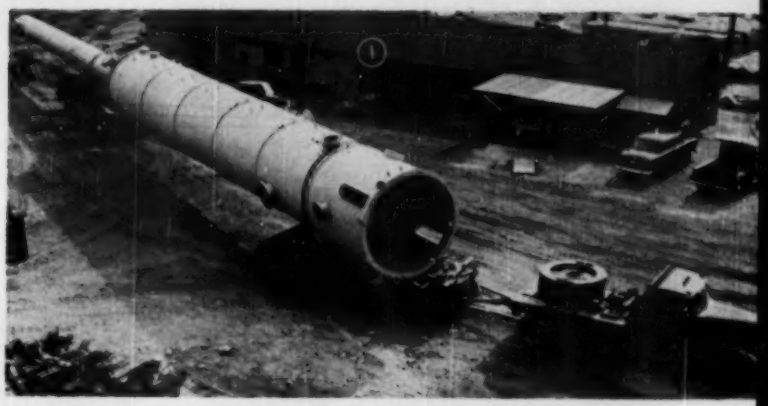
Some noteworthy experiences from operation of the plant since the revision are that final stripping of the lean oil is now being carried out entirely by preheated hydrocarbon vapors, thus eliminating the steam requirement to the distillation system except as a preheating stream for the hydrocarbon vapors. The total plant steam requirement has been reduced some, even though the extension design did not presume any major savings in steam consumption. Primary uses for steam are to drive turbines and pumps and to heat fractionator reboilers. The outlined method of oil stabilization and reabsorber overhead control has proven very precise or positive and provides a flexible means of controlling the ultimate propane recovery. Based on plant gas loads available since the extension, the contract commitment of installing equipment to recover at least 85 percent of the propane in the inlet gas has been fulfilled and exceeded.

Gasoline Plant Construction Corporation of Houston was engineering and construction contractor for the project.



In the left foreground are the high pressure raw make tank, low pressure raw make tank and the refrigerant system surge tank. The two small columns are product dehydrators with the product pre-drier at the right.

Advance Planning Facilitates Rigging Job

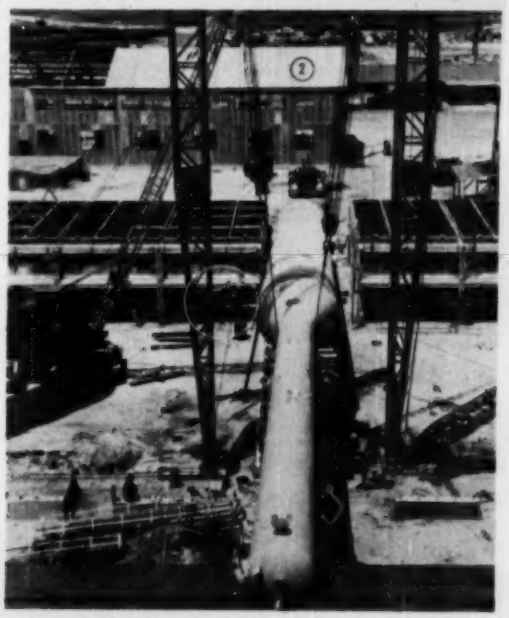


ERECTING a fractionator can be a quick and smooth operation if all details are well planned. Such advance engineering is the rule now, and as a result most process equipment goes into place on schedule and without incident.

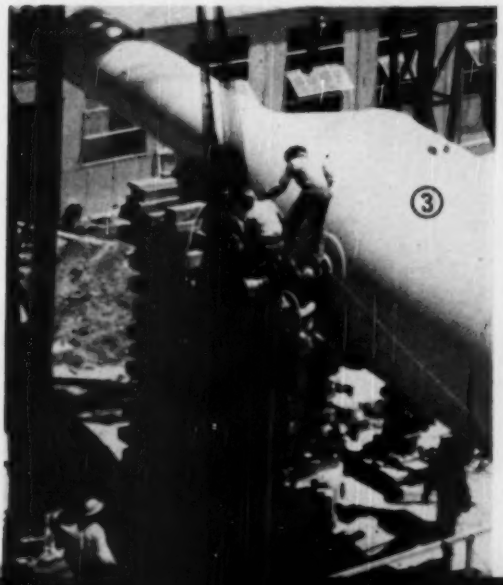
The series of photographs show a tower erection in restricted space at the Wasson field gasoline plant which is operated jointly by Shell Oil Company and Coltexo Corporation.

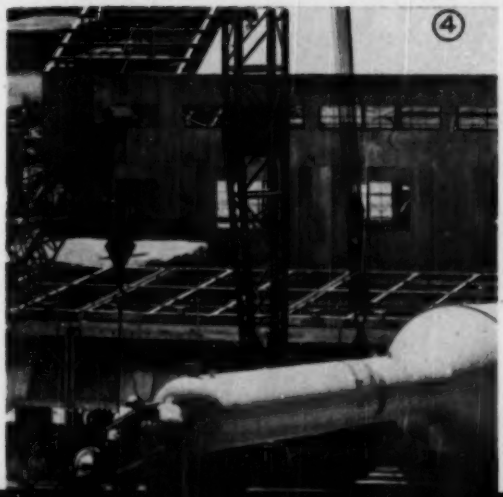
This tower, a rich-oil deethanizer, is 48 inches and 120 inches in diameter by 125 feet high.

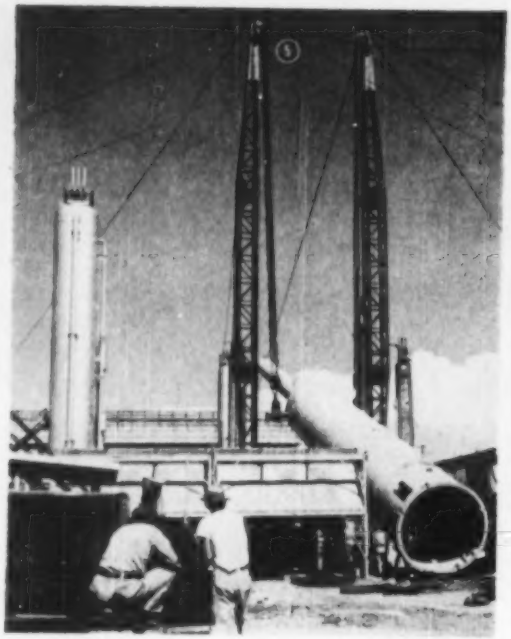
Photograph 1 shows the movement of the tower to the erection site by special wheeled trailers. The next view (2) shows the tower spotted between two booms that are to be used to lift it into place on its foundation. The tower has been pulled through a narrow aisle between other process equipment installations and the top end barely clears a building roof. Cribbing has been stacked to hold the tower clear of this roof. Special openings and a cylinderical beam were used in lieu of conventional lifting lugs to raise the vessel to its final vertical position. The beam was lifted by motor crane for insertion through the



Inset below is blowup of the circled portion of Photo 2 at right and shows the men standing on the beam adjusting the lift cables.







vessel, as can be seen here. The men standing on the beam are adjusting the lift cables from the motor crane so that the beam can be slipped through the tower.

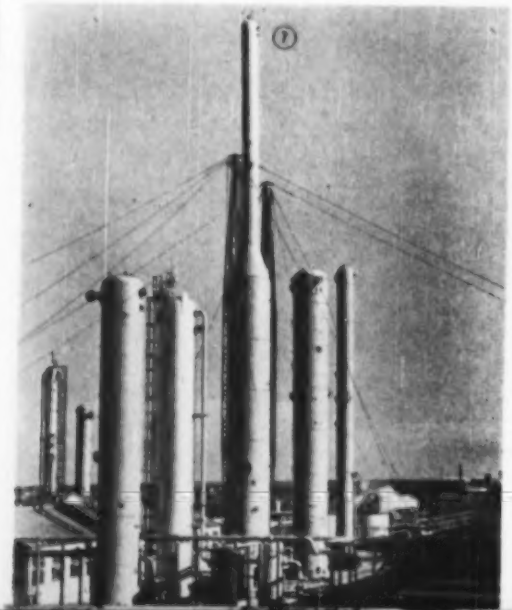
In Photo 3 the beam can be seen in place through the tower and the main lifting lines have been attached. The cable sling around the under part of the tower which served to handle the load until now, has been removed.

In View 4 the men are bolting on the top-tower platform and ladders. The tower in vertical position has its top end well above the two booms. Ladders attached to the upper part of the tower will provide easy access to the top platform.

No. 5—The big lift starts and goes on up smoothly. Since the base of the tower could swing as a pendulum to damage the building in the foreground (and the tower) care was used to skid it forward gently (Photo 6.)

No. 7—The tower is up. As soon as foundation bolts are fastened securely it will be safe enough. Later a surveyor with a transit probably will help to establish a true vertical position for the big vessel. Lined up with metal shims, the base will then be grouted with cement mortar.

Photo 8—The lifting beam must come out and the booms down. While the tower is in place, there is still a lot of work to do.



Rich Oil Deethanization Used As Process Scheme at Chico

F. G. CRAWFORD, J. C. HANNAH, and A. M. WHISTLER
The Fluor Corporation, Ltd., Los Angeles

***CITIES SERVICE** Oil Company placed a new gasoline plant in operation during January of this year. The plant, located about five miles west of Chico, Wise County, Texas, about 60 miles northwest of Fort Worth, was designed and constructed by The Fluor Corporation in collaboration with Cities Service Oil Company engineers. Distinguishing features of this plant include application of rich oil deethanization as the process scheme, the use of purchased electric power for nearly all drives, and provision for expansion to triple the starting capacity. The reasoning that led to this last decision for expansion facilities will be of high interest to natural gasoline plant operators and designers alike.*

The authors are all connected with The Fluor Corporation, Ltd., Crawford being senior engineer, Hannah, process engineer, and A. M. Whistler, assistant chief process engineer.

IN ANY developing oil field, it is difficult to establish a satisfactory design basis for a new gasoline plant. Many factors contributed to the selection of 22.5 million standard cubic feet daily as the ultimate design capacity for the Chico plant. All fractionating columns, process pressure vessels, and piping, and all plant utility facilities were installed to accommodate the eventual plant. However, some of the equipment was installed to handle one-half or one-third of the plant capacity, since it was contemplated that initial operations would be at about 6.5 million SCF daily. In every instance where equipment with less capacity than the ultimate was installed, provisions were made for adding equipment at minimum expense.

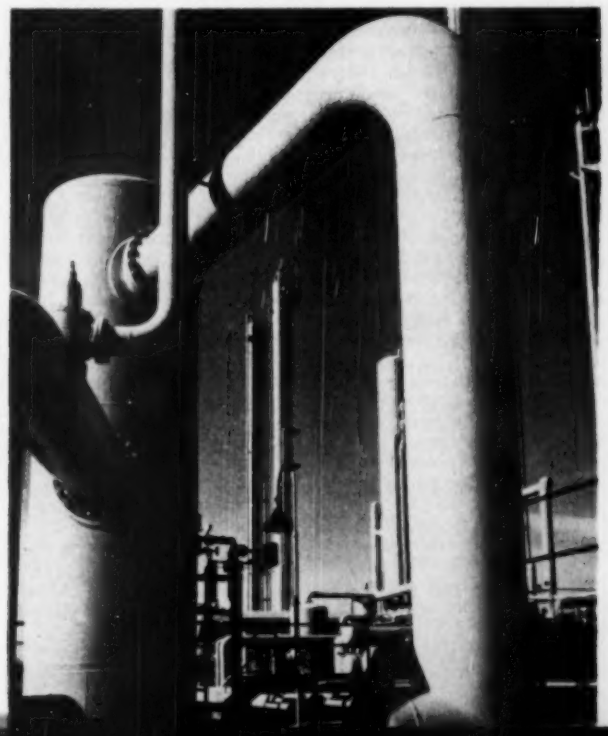
For example, the compressor plant now contains two 600-hp. 3-stage units. The compressor building and the piping layout are designed for an ultimate expansion to seven similar engines with a minimum disturbance to the existing equipment. Except for the starting air equipment, compressor auxiliaries such as jacket water pumps and lube oil coolers will require duplication as additional compressors are installed.

In the same way, certain of the atmospheric coolers and condensers were purchased for one-half of the ultimate plant capacity. Provision has been made in the cooling tower coil shed for installation of these omitted sections at a later date. The ultimate plant will require four induced draft cooling tower cells; only two of these cells are installed at present over a coil shed sufficiently large to accommodate all process cooling facilities for the ultimate plant. The cooling tower is divided for ultimate operation into "hot" and "cold" sections, which will require separate pumps with a common standby. Only two cooling tower circulating pumps are now installed and operate one at a time. This results in mixing the water from the "hot" and "cold" sections, but this mixing does not hinder present operation.

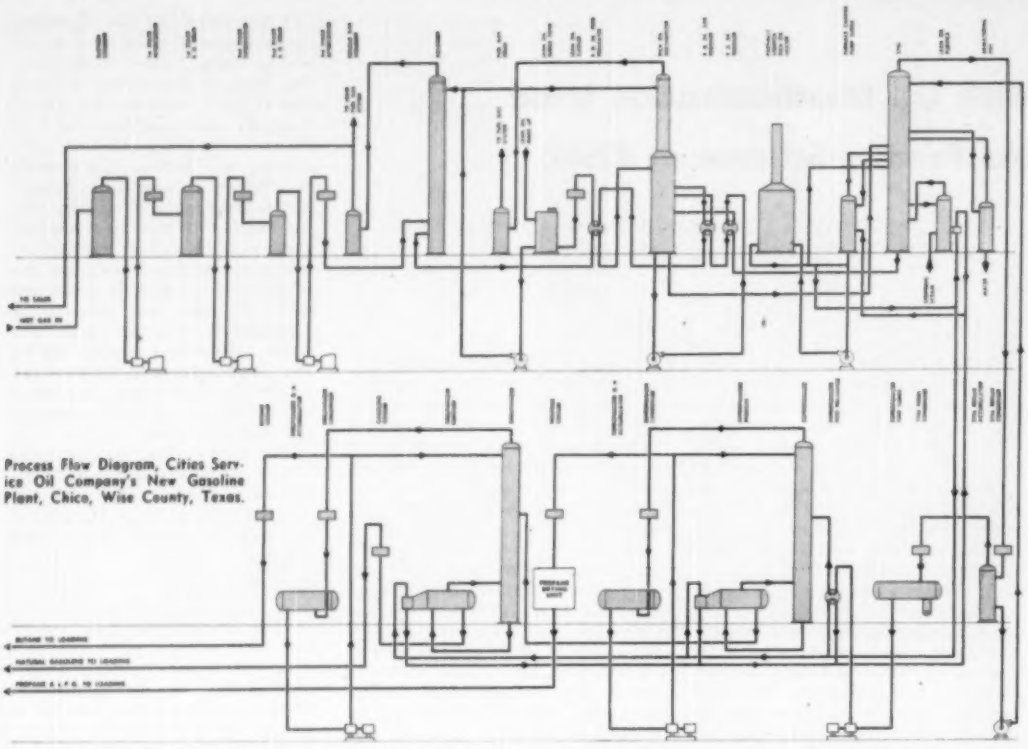
The excess capacity of the existing cooling tower is now being used to cool jacket water in an atmospheric section. With plant expansion it will be necessary to convert this particular section into a gas cooler (the section was specifically selected for this) at which time jacket water cooling will be accomplished using fin fans.

The fired heater supplying heating medium to the plant was installed for one-half the ultimate plant capacity. In the same way, the pressure storage vessels for production storage were installed to accommodate only the initial anticipated production rates.

The use of both suction and discharge pulsation dampeners for each of the three compressor stages reduced vibration to the extent that no hold-downs are required for piping at any point in the plant except for anchor



Slender towers reflect the old problem of small plant designers—fractionators for a given separation require a specific number of trays without too much relation to the capacity of the tower. Direct line arrangement of piping on low concrete piers, low crossover walkways for the operators, and instruments positioned at the equipment they serve all contribute to the simple layout.



Process Flow Diagram, Cities Service Oil Company's New Gasoline Plant, Chico, Wise County, Texas.

points to control stresses produced by thermal expansion. Further economies were permitted by the use of dampeners in sizing of compressor headers and laterals. With the essentially steady flow effected by the dampeners, the diameter of this piping was reduced below pipe sizes which would have been required for full pulsating flow, without any increase in pressure drop.

A study was made to determine the type of prime movers to be used in the plant, as the result of which it was decided to drive all centrifugal pumps and the starting and instrument air compressors with purchased electric power. A stand-by gas engine driven starting air compressor is provided with an emergency make-up connection from starting air to instrument air. The boiler feed pumps and several of the process pumps are steam driven reciprocating units, selected for low capacity-high head services. By proper selection of the live steam pressure at 235 psig., with the pumps exhausting against 125-psig. back pressure, the plant at its ultimate design capacity will be in balance as far as steam is concerned; that is, the pumps will use almost exactly the quantity of steam required for stripping in the process.

The location of the plant is sufficiently isolated that no commercial source of domestic water was available. The water problem was solved by drilling a productive well near the plant site. The electric motor driven well pump is automatically turned on and off by a pressure switch which is actuated by the level in the raw water storage tank at the plant.

The plant layout was arranged to result in the lowest initial cost consistent with safety and operating accessibility. Fractionating towers and other process vessels were located in an east-west row, flanked on the north by the process pumps and the control house, and on the south by the main process pipe lane. South of this pipe lane are the suction gas cleaner and interstage compressor knockout drums and the cooling tower.

East of the fractionating column row is the compressor house, with its axis north-south. The compressor gas piping headers are between the compressor house and the process columns; the compressor utility piping headers are either inside or along the east side of the compressor building.

Propane, butane, and gasoline storage tanks are located west of the process area and sufficiently remote from it to conform with good safety practice. Truck loading facilities are provided north of the storage tank area.

The process heater, boiler house, transformer bank, electrical switch room, change room, office, laboratory facilities, and warehouse are located north of the process area and 150 feet distant from the process area fractionators or the compressor house. This entire area is classed as non-hazardous, which permits the use of open type transformers, circuit breakers, and starters for the entire plant.

Gas enters and leaves the plant south of the cooling tower near the domestic water storage tank. The plant flare is located about 200 feet south of this point, outside the fence.

All process pumps are in the open, located near the vessel from which they obtain suction, with plenty of room around them for access to equipment. Piping adjacent to operating equipment is carried overhead, but piping in all pipeways is on sleepers 9" above grade. Provisions have been made in piping layout to extend headers for ultimate plant expansion with minimum disturbance to existing piping.

Except for water lines subject to freezing and sewers and drains, there is no buried piping. Steel stiles are provided for crossing the pipe lanes at

walkways. An exception to the above is that vapor lines from fractionating columns are carried overhead to condensers in the cooling tower.

The control house, located adjacent to and north of the process area, is centralized to minimize the length of instrument piping and wiring and for operating accessibility.

Process Description

Rich oil deethanization was selected as the processing scheme since past studies have shown that this scheme results in low capital and operating costs in the range of propane recovery (70 per cent) involved. Special heat exchanger arrangements result in good heat economy.

The sequence of processing steps is:

1) Compression of the wet gas.

2) Absorption of the heavier hydrocarbons from the gas.

3) Deethanization of the rich absorption oil from the absorber.

4) Stripping of the deethanized rich oil.

5) Depropanization of the unstabilized gasoline from the still.

6) Debutanization of the gasoline from the depropanizer.

The wet gas from the field enters the plant at a design pressure of 0-10 psig. and passes through a gas cleaner for the removal of any entrained particles of solids and liquid. The gas cleaner is initially charged with absorption oil and any liquid that builds up is drained or pumped (under liquid level control) to a burning pit.

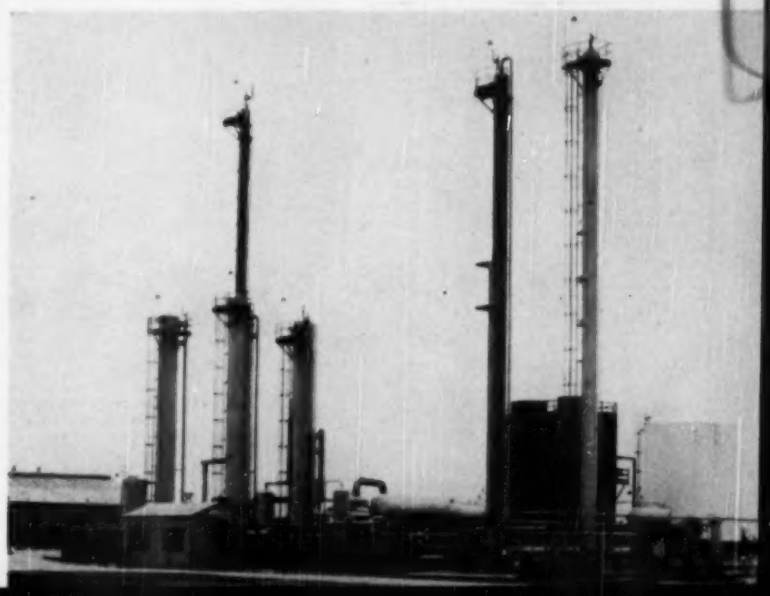
Compression equipment now installed consists of two 600-hp. compressors. Three compression stages are required with two low pressure, one intermediate, and one high pressure cylinder per machine. Intercoolers cool the gas between stages and the gas from the final stage discharges through an aftercooler into the absorber. The suction of each stage is provided with a knockout drum. The compressors are protected with shutdown devices that stop the engine if the oil pressure becomes too low or the jacket water temperature becomes too high. An overspeed trip also stops the engine as do high level swicthes on the gas cleaner and intermediate knockout vessels. The compressor jacket water system is a circulating stream of softened water cooled by an atmospheric section in the cooling tower; a by-pass around the cooling coil, with a temperature recording controller and butterfly valve, serves to regulate the water temperature. The lubricating oil is pumped through shell and tube exchangers cooled by warm water circulated from the cooling tower.

Gas from the compressors enters the 54-inch diameter, 24-tray absorber at pressures up to 500 psig. Residue gas from the absorber passes through a gas cleaner for removal of entrained lean oil and enters the gas company system. Provision was made for installing an intercooler on the absorber in the future. Lean oil flow to the column is regulated by a hand throttling valve and the flow rate is recorded on a local flow recorder. A water drawoff boot is provided on the bottom of the absorber and water is intermittently drained at this point.

The rich oil from the bottom of the absorber is preheated (by exchange with the stripped lean oil going to the coolers) and charged to the rich oil deethanizer. This column is swaged with a 60-inch diameter bottom section and 30-inch diameter top section. Twenty absorption and 20 stripping trays are provided. A portion of the rich oil is by-passed around the preheater and enters the deethanizer two trays above the preheated stream. The feed liquid joins the enriched lean oil from the absorption section of the deethanizer and flows down over the stripping trays. Stripping vapor generated by the side and bottom exchangers serves, with the aid of the absorption (or rectifying) section, to fractionate the ethane and lighter constituents from the propane and heavier hydrocarbons. Removal of the ethane and lighter hydrocarbons greatly increases the boiling point of the remaining liquid so that it is necessary to add much sensible heat in the lower part of the column. This is most economically accomplished by exchanging the hot lean oil from the still with the liquid in the deethanizer stripping section. The hot lean oil first adds heat to the liquid from the bottom tray of the deethanizer, then to the liquid from the fifth tray from the bottom. The cooled lean oil from this "side" exchanger then finally exchanges with the rich oil from the absorber and flows to the lean oil coolers. Thus, three separate exchanges with hot lean oil serve to provide the heat required for deethanization.

The lean oil flow to the deethanizer is controlled by a flow recorder controller. The amount of deethanization is controlled by regulating the bottom temperature of the column. This is accomplished through by-passing some of the hot lean oil around the reboilers, or by changing the stripping temperature in the still. Water is separated from the liquid leaving the bottom tray and drawn off by an interfacial level controller.

Hot deethanized rich oil from the deethanizer flashes into the 54-inch diameter, 20-tray still at 80-110 psig. and the liquid is partially stripped on three trays before the oil is drawn off for reheating. This liquid gravitates into a surge vessel from which it is pumped to the heater. Hot oil returning from the heater is split into three streams. A level controller on the furnace charge surge vessel regulates the stream entering the stripping section (10 trays) of the still. A second stream serves as heating medium for the depropanizer, debutanizer, and lean oil purifier heating services. The cooled oil from these services is returned to the furnace charge surge tank. The third



General view of the Chico gasoline plant process area. Through skillful design this plant has a compact layout well suited to its comparatively small size.

stream is used to regulate the back pressure on the furnace and is returned to the surge tank also.

A portion of the lean oil from the stripping section is drawn off to the lean oil purifier where it is exposed to all of the stripping steam and all but the undesirable contaminants are vaporized and returned to the column. The contaminants are periodically drawn off.

The stripping steam rate is hand controlled, using a local flow indicator and globe valve. Stripping steam is supplied by having the reciprocating pumps exhaust at 125 psig. into a knockout vessel for condensate removal. Any make-up steam required is automatically admitted to the system by a pressure reducing controller from the 235 psig. high-pressure steam. Any excess steam is bled off to a steam exhaust head under hand control.

The gasoline end point is controlled by a temperature recorder controller which regulates the still top temperature by changing the reflux rate. Still reflux is condensed in a partial condenser with the still reflux accumulator running liquid full. The vapor-liquid mixture passing out the top of the reflux accumulator goes through the final condenser and the liquid enters the depropanizer feed surge vessel. Since this feed is totally condensed, the still pressure is controlled by means of bypassing vapor around the reflux condenser to the vapor space of the surge tank or, if necessary, by venting vapor from the surge tank.

Water that condenses in the top trays of the still is removed by passing the liquid from the fifth tray through a dewatering pot from which the water is drained by an interfacial level controller. A similar controller continuously drains water from the reflux accumulator. Any water which collects in the depropanizer feed surge vessel is periodically drained off.

The 30-inch diameter, 40-tray depropanizer is charged by a reciprocating pump taking suction from the feed surge vessel. A pressure controller on the pump discharge regulates the steam to the pump with a flow recorder controller throttling the feed to the column. This charge rate is occasionally reset manually to maintain a proper level in the feed surge vessel. Pressure control on the depropanizer as well as on the debutanizer is accomplished by bypassing vapors around the condenser into the vapor space of the overhead accumulator. The propane to storage is drawn off through a liquid level controller from the discharge of the reciprocating reflux pump and, after cooling and dehydration in twin alumina dryers, flows to the storage tanks. The reflux returned to the column is regulated by a flow recording controller. A temperature recording controller on the column regulates the heat input to the reboiler. Water is occasionally drawn off from the overhead accumulator.

Depropanized gasoline is withdrawn through a liquid level controller from the depropanizer reboiler and flashes into the 30-inch diameter, 40-tray debutanizer. The debutanizer control and operation is similar to the depropanizer except that the temperature control point is at the bottom of the column to regulate gasoline vapor pressure, and no butane drying is required. Butane and gasoline are cooled and flow to storage.

Gasoline storage consists of two 9 x 40-foot vessels, butane of two 8 x 60-foot vessels, and propane is stored in two 9 x 60-foot vessels. A 9 x 60-foot vessel is provided for liquefied petroleum gas mixes. The butane, propane, and liquefied petroleum gas tanks are vented by back pressure regulators to the suction of the compressors. Provisions are made for rerunning off-specification propane or butane. Truck loading facilities are provided.

Boiler Plant

The boiler plant consists of two 150-hp. fire tube boilers, one operating with 100 per cent standby. The feed water is softened by zeolite treaters, and is deaerated before being charged to the boiler.

Buildings

The plant buildings are all of prefabricated, corrugated iron construction.

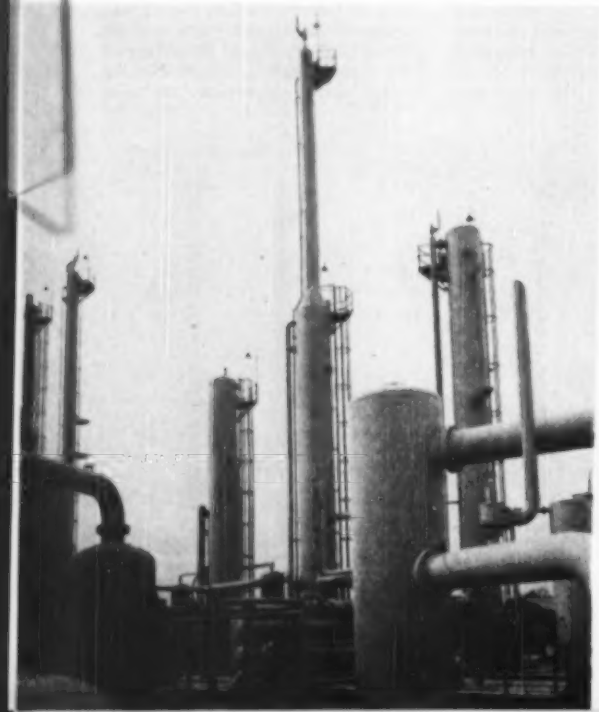
The buildings include a warehouse and laboratory building, a boiler house, washroom, and electrical switch room building, compressor house, and control room. With the exception of the compressor house, they are all steam heated with circulating unit heaters.

Safety Equipment

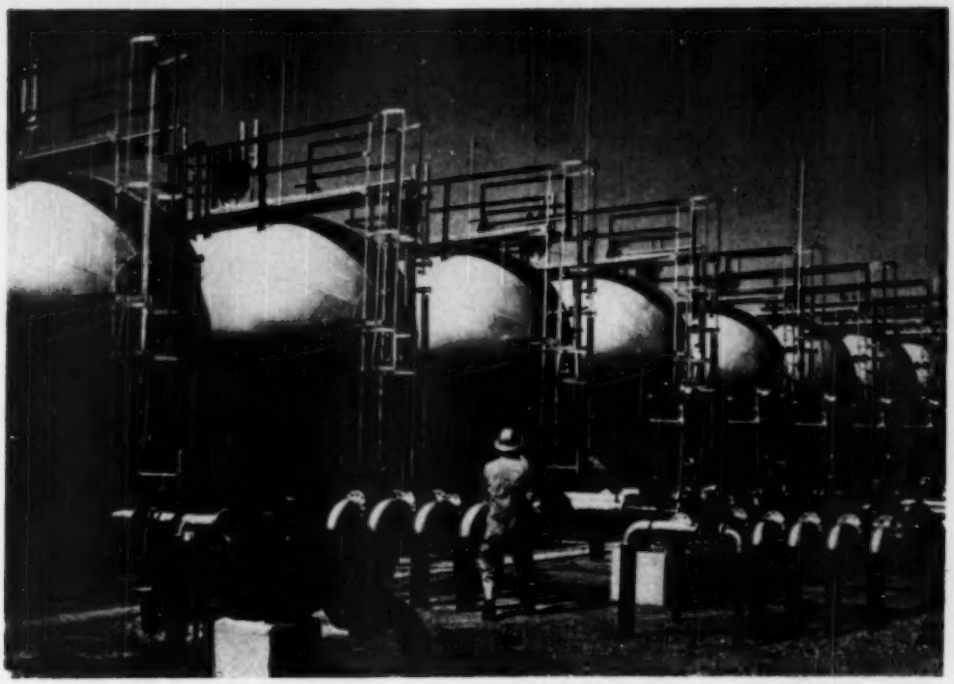
Steam and water service points are strategically located in the process area. The vessels are equipped with relief valves popping to the atmosphere. Class 1, Group D electrical equipment is used in hazardous areas. A manually reset low-pressure positive shutoff valve is used on the fuel gas to the furnace and boilers to keep unignited gas from entering these fireboxes after a fuel gas failure.

Plant Fuel Gas System

The residue gas from the rich oil deethanizer serves as the main plant fuel. Any excess fuel requirements can be made up from wet gas taken from the second stage suction of the compressor plant or from the absorber residue gas system. Any deethanizer residue gas excess not needed for plant fuel recycles to the second stage of the compressor plant and eventually leaves with the absorber residue gases.



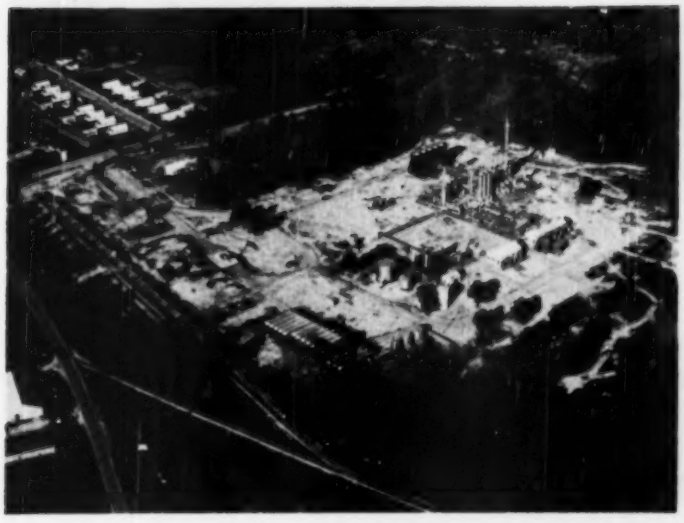
Pumps are for the most part located near the equipment that they serve. Structures on towers are adequate for operating and inspection purposes, but have been held to the minimum.



Products storage tanks are in the background with loading pumps and pipe manifold in the foreground. Operator switches valve on pump suction manifold.

Humble's Opelousas, La., Gasoline Plant on Stream

Gas plant is seen from air. Humble employes' camp is in the left background. The plant is adjacent to the Texas and New Orleans railroad line, so spur track with loading rack is conveniently near the plant. The track is seen at left.

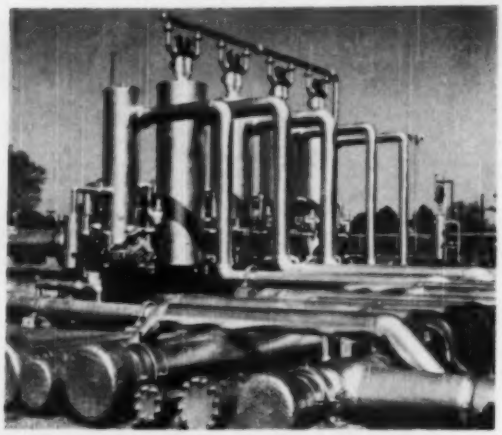


HUMBLE Oil & Refining Company recently placed on stream the Opelousas gasoline plant to process 100 million cubic feet daily of natural gas from North Crowley, North Tepetate, Pecan Island, the Branch, North Cankton, Shuteston, South Shuteston, Bayou Mallet, and Lewisburg fields in Louisiana. Employing an absoprtion-refrigeration type process, the plant will produce propane, butane and natural gasoline. Location is on a 63-acre site near Opelousas, La.

The plant, constructed by Hudson Engineering Corporation, Houston, is equipped with 1320 horsepower for electrical power generation, and boilers that deliver 120,000 pounds per hour of steam at 400 psi. in addition to extensive distillation and fractionation equipment. Products are shipped from the plant by tank truck and railroad tank cars loaded at a 30-car loading rack.

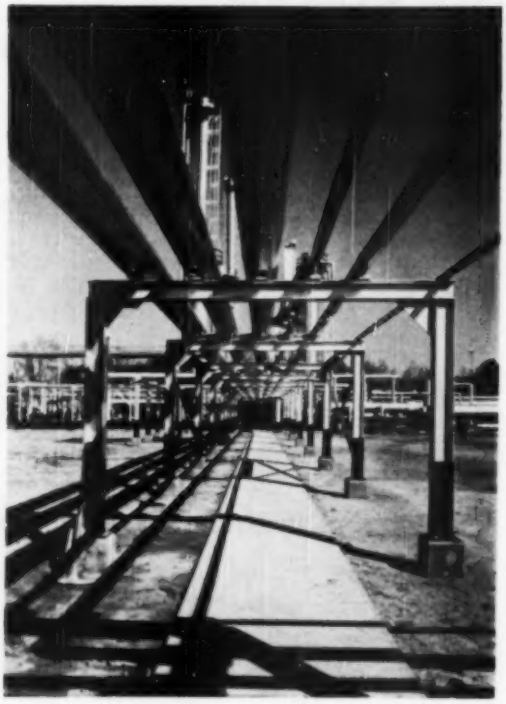
Additional photos of this plant appear on next page.

Operator sets pressure regulator in a battery of backpressure regulators for maintaining the desired storage tank pressures.

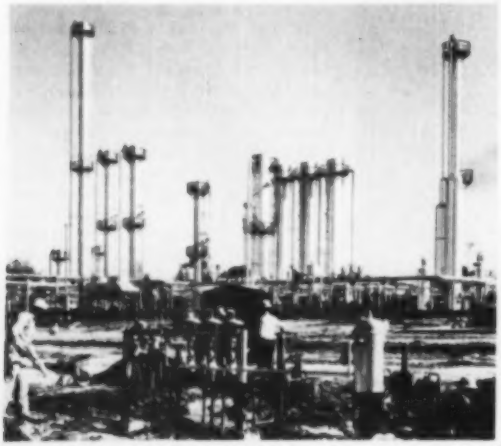


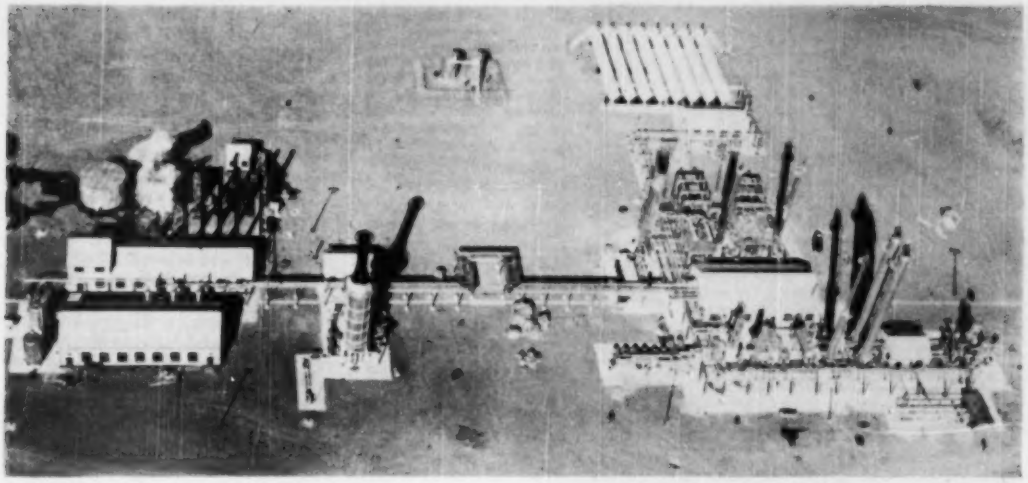
A view of compressor, suction, and discharge headers is in the foreground with the refrigeration system scrubbers in the background. The major portion of the compressor station is devoted to refrigeration services, and for this reason, the majority of the lines are insulated.

Walkway under pipe rack connecting boiler station to distillation section of the plant is shown. The rack is supporting live steam, exhaust steam, and condensate lines.



Foreground shows main inlet gas valve to the plant. The small regulators on the rack prodvide gas for operating the turbine motors shown on the main block valves. In the background is a general view of the distillation area showing absorbers, still, and fractionators.





Above is an aerial photo of the entire Hickok plant except the cooling tower. Left, foreground is the generator building. Just back of it is the boiler and water treating building. The two tanks back of that building are the raw and treated water storage. To the right is the oil heater. In the center background are two absorption oil storage tanks. To the right of them is the product storage. In the picture at the right are the process pump house setting in the center of the process area. Above this, left right, are the still, stabilizer and deethanizer towers with allied equipment. Below the pumphouse, left to right, are the oil and oil exchangers, lean oil surge, reabsorber, the twin absorbers. A building, just to the right, covers the meter loops, measuring gas entering and leaving the absorbers and oil entering the absorbers. Next to the right are the inlet and residue gas scrubbers.

Residual Gas Btu. Control Stressed in New Plant

CHARLES W. FRANK
Walco Engineering and Construction Company, Tulsa

MAGNOLIA Petroleum Company's Hickok gasoline plant, located 10 miles east of Ulysses, Grant County, Kansas, was placed in operation in December, 1949.

Wet gas enters the plant from an extensive gathering system. Normal operating pressure is 250 pounds; however, the plant is designed to handle gas up to 400 pounds pressure.

IN GENERAL, the operation of gasoline plants is based on optimum recovery of propane from the feed gas. The demand of pipe line companies for natural gas, however, has introduced another factor which must be considered in operation of plants supplying gas to these pipe lines —minimum heat content of the residue gas. Magnolia's new Hickok plant supplies residue gas having a minimum specified heat content of 950 Btu. per cubic foot. The absorbers extract all available products over and above those necessary to maintain the heat content required.

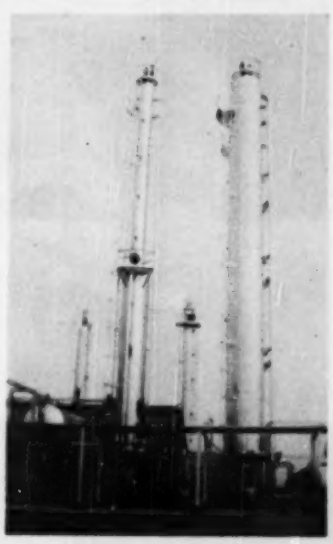
The plant is designed to process initially 134 million standard cubic feet of natural gas per day, recovering a total daily production of approximately 65,000 gallons and delivering residue gas at a constant specified heat content to Cities Service Gas Company's compressor station.

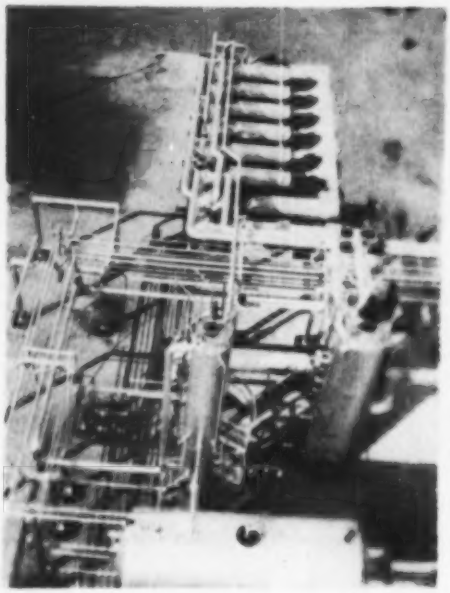
The controlling factor in the operation of the Hickok plant is not a specified product recovery, but the maintenance of 950 Btu. per cubic foot of residue gas.

The gas is processed through twin absorbers and the heat content of the residue gas leaving these absorbers is maintained automatically by a calorimeter recording controller. This instrument measures the heat content of the residue gas and resets two ratio flow controllers, one on each absorber, thus controlling the amount of absorption oil pumped to the absorbers. By this method of control enough oil is supplied to the absorbers to extract all available products over and above those necessary to maintain the heat content requirement.

A centrifugal pump takes suction from a lean oil surge tank and discharges oil to the suction of other centrifugal pumps for boosting to the absorbers. A side stream from the low-pressure pump feeds lean oil to the reabsorber. The high-pressure lean oil

Twin absorbers on the right. Left foreground is the reabsorber. Left back ground is the stabilizer. Right back ground is the deethanizer.





This is looking down on the oil to oil exchangers. The vessel in the lower right is the rich oil flash tank. The vessel at the bottom is the lean oil surge tank and the one just above it is the lean oil contactor.

pumps are so set up that two pumps operate in parallel at the normal operating pressure of 250 psig., and in series when operating at pressures up to the 400 psig. design.

The rich oil from the absorbers flashes into the reabsorber at 90 psig. and is pumped through exchangers, direct fired oil heater, flash tank and still. The still operating at 100 psig. affords enough pressure that excess vapors from the raw gasoline feed tank flow back to the reabsorber.

The raw gasoline at 100 psig., is pumped into a 36-tray deethanizer operating at 495 psig. The bottoms from this tower feed the 30-tray stabilizer where a mixture of propane and butane is taken overhead as a plant product and 22-pound Reid Vapor Pressure product is withdrawn from the reboiler.

The cooling tower is a two-cell, induced-draft tower designed to cool 3000 gpm. of water from 115° F. to 85° F. with an 80° F. wet bulb. Vertical cooling tower water pumps pick up the cooled water from cooling tower basin and deliver it through the plant for various cooling duties and back over the tower. All water cooling is by shell and tube units.

Heating in the plant is accomplished by a direct fired rich oil heater and by steam. The rich oil passes through the heater and is delivered to the still at 500° F. thus allowing the still to operate at 100 psig.

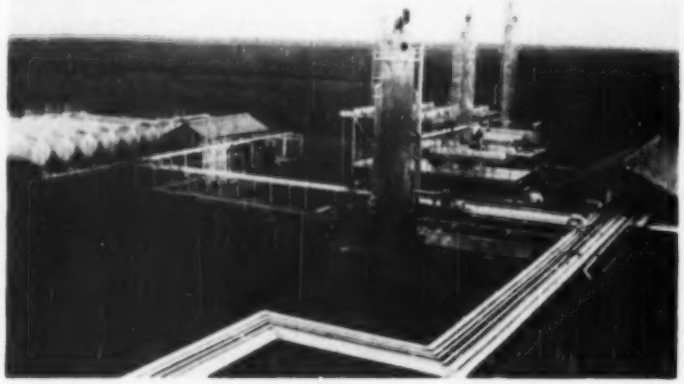
A boiler plant supplies steam for all other heating requirements in the plant. This system utilizes two separate steam systems—a 250-psig., and a 100-psig., system. The steam is generated by four 104-hp. oil field type boilers at 250 psig.

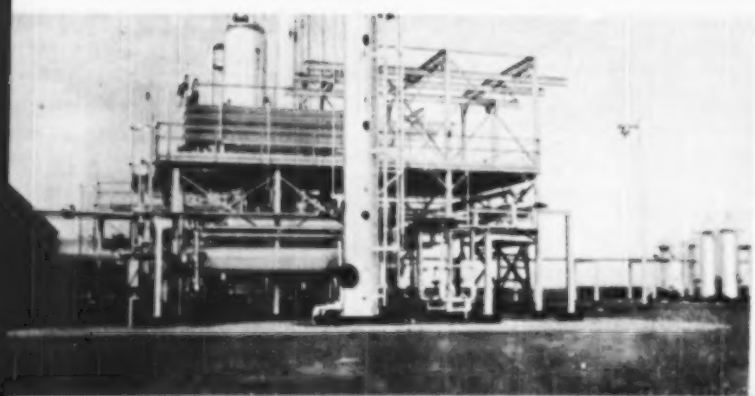
The steam from one rich oil pump turbine and the fractionator charge and reflux pumps exhausts into the 100-psig. system thus supplying steam for the still and various other heating. Any excess 100-psig. steam is passed through an exchanger heating the boiler feed water.

Steam condensate from various points in the plant is returned to a skimmer tank where oil is trapped. The condensate goes on to the boiler feed tank.

Plant water requirements are supplied from two water wells on the plant site. This raw water is treated by a cold lime-soda process for use throughout the plant. The cooling tower water is chlorinated at the tower. Chlorinator facilities are also installed to further treat water for office and camp facilities.

Plant electric power requirements are supplied by three 250-kw., 440-volt, 3-phase, 60-cycle gas-engine driven generator units. This power station is equipped with a fully enclosed switchboard and power panels. Motor starters are grouped and placed on racks near each group of motors. Individual push button stations are





Upper left—This is a general view showing storage on the left, the loading pump house in front of the storage, the tower in the foreground is the still, the next one stabilizer and the one in the back ground the deethanizer. The building on the right is the process pump house and just back of it is the cooling tower.

Lower left—The building on extreme left is the process pump house which houses the instrument panel, all the oil pumps and the fractionator pumps. The tower in the foreground is the deethanizer and back of it is the various allied fractionating equipment.

mounted at each pump.

Plant product storage consists of four 1000-barrel horizontal natural gasoline tanks and four 1000-barrel horizontal LPG tanks. A loading pump is provided for each product. These pumps discharge to both the tank car and truck loading racks. A six-spot truck loading rack is installed within the plant boundaries. A 2000-barrel raw water, 2000-barrel treated water and tank car capacity absorption and lube oil tanks make up other storage in the plant.

Particular attention has been given to safety features in the design and construction of this plant. The various operating areas are compact within themselves, yet allowing adequate space for ease of operation and maintenance.

A water fire fighting system is installed with non-freezing hydrants so located within the plant that all points are readily accessible. This system is fed by a centrifugal pump having a capacity of 500 gpm.

Steam snuff lines are installed on boiler and oil heater furnaces and are remotely controlled within the plant site.

Manually operated shutdown control points are located in non-hazardous areas within the plant.

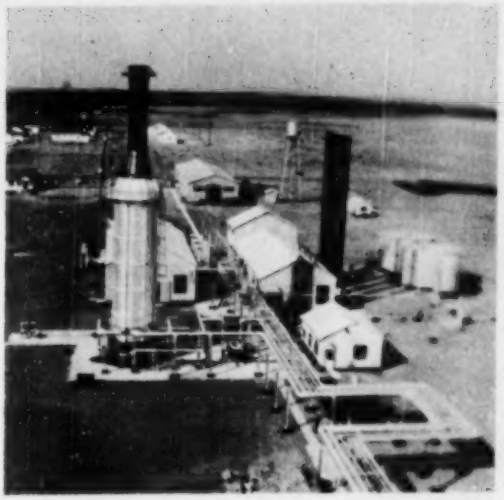
All relief valves on process vessels are paired and provided with locking block valves.

All vertical vessels over 15 feet high are provided with safety cage ladders and platforms at manways and on top of the vessel to make relief valves readily accessible for inspection and testing.

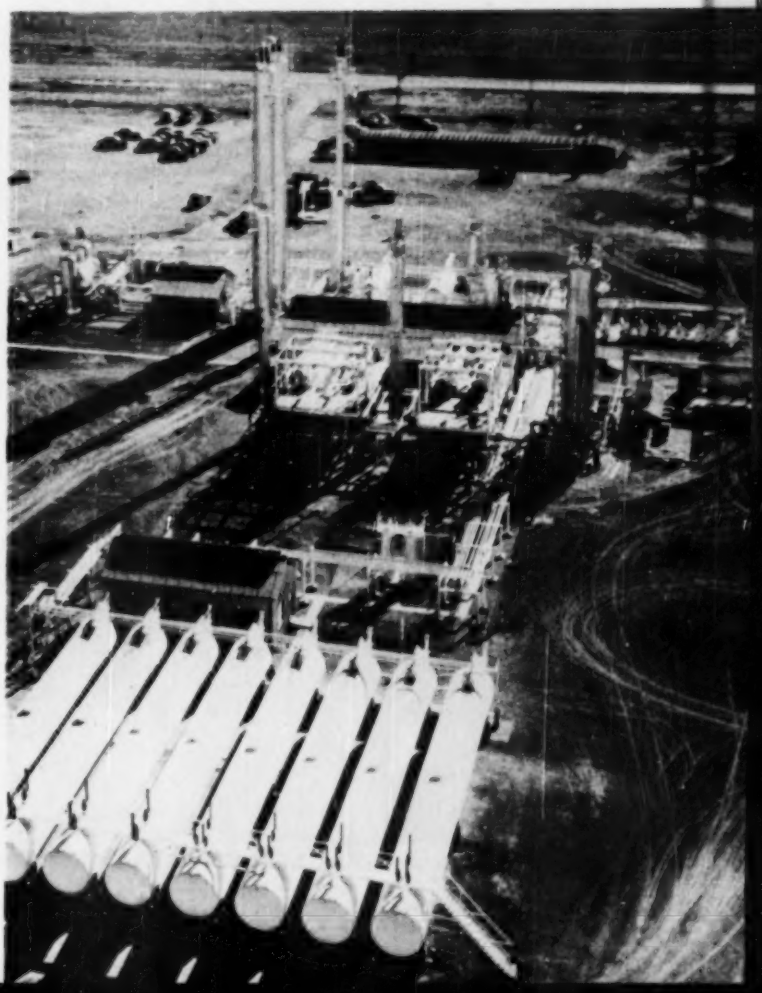
Precautions have been taken to prevent freezing during winter months. Outside points likely to freeze were steam traced and insulated. A process pump building was installed housing all process pumps, water leg on raw feed accumulator, and the control instrument panel. Meters and controls so located as to be impractical to install in this building are protected with individual steam heated enclosures.

Magnolia Petroleum Company personnel in charge of this project included C. V. Edwards, Jr., general superintendent; R. H. Illingworth, chief mechanical engineer; D. T. McDonald, chief process design engineer; J. L. Brown, district superintendent, Pampa, Texas, and John R. Leonard, project inspector.

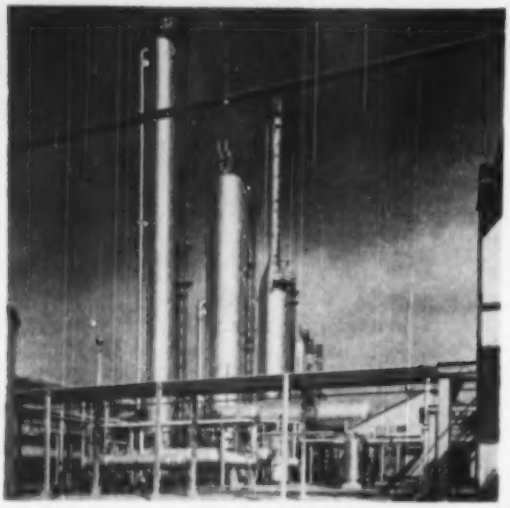
The contract for the design and construction was with Walco Engineering and Construction Company, of Tulsa.



In the lower lefthand corner are the oil to oil exchangers. Pipe lane is the steam and oil piping from the boiler house and heater to and from the process area. This also shows the boiler building to the right and the generator building back of the oil heater.



Right—An aerial view looking south. The storage area in the foreground. The process area in the back ground. The cooling tower on the left.



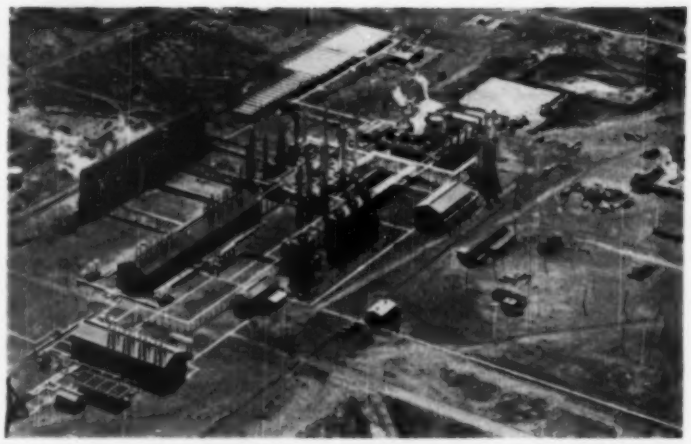
New distillation added to the Wasson No. 2 plant in West Texas. The depropanizer is in the foreground, and the still, rich oil deethanizer, and two absorbers are in the background.

Process Facilities Enlarged at Wasson Plant

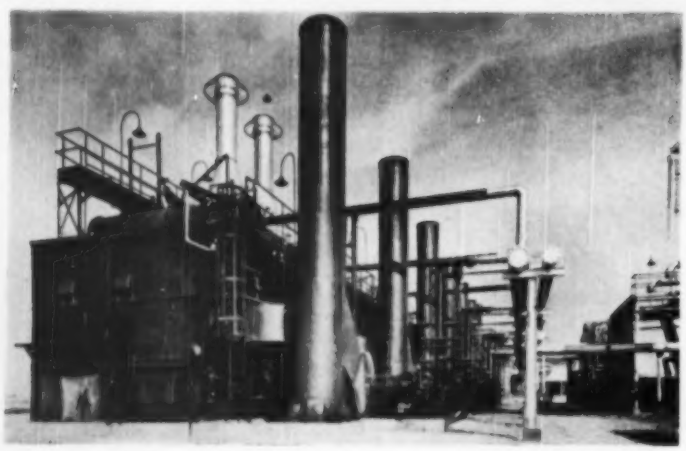
PROCESSING capacity of the Wasson No. 2 gasoline plant was recently increased from 66 million to 96 million cubic feet daily of casinghead gas. The addition of new facilities and a revision of the process also increased the recovery of propane to 65 percent. Production of the plant under design conditions is 121,000 gallons per day of propane and 193,800 gallons per day of depropanized gasoline. Due to the current curtailment of crude oil production in the Wasson field, the plant is operating below capacity.

The plant, installed to conserve casinghead gas flared in the Wasson field, Yoakum County, West Texas, is owned jointly by Shell Oil Company, and the Coltexo Corporation. By agreement, Shell operates and maintains the plant. Residue gas from the plant is sold for public utility power generation and carbon black manufacture.

Major equipment added to the plant consists of eight 800 horsepower compressors, three boilers, a complete electric generator system, two absorbers, rich oil deethanizer, still, depropanizer,

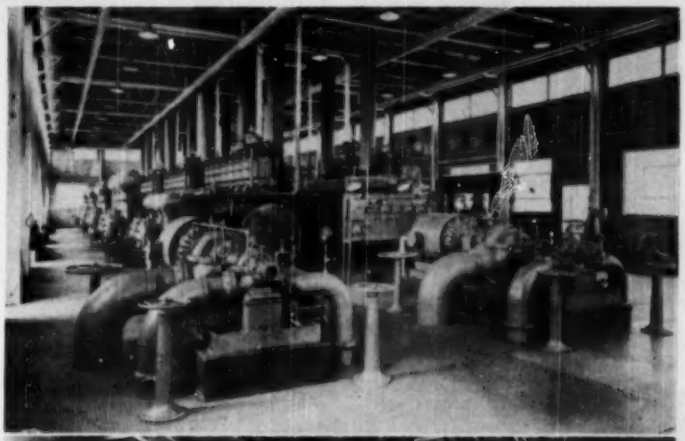


Above—Wasson No. 2, gasoline plant in the Wasson field, Yoakum County, West Texas, owned jointly by Shell Oil Company, and the Coltexo Corporation. Design capacity of the plant was increased recently to 96 million cubic feet daily of casinghead gas. Operation of the plant is by Shell.

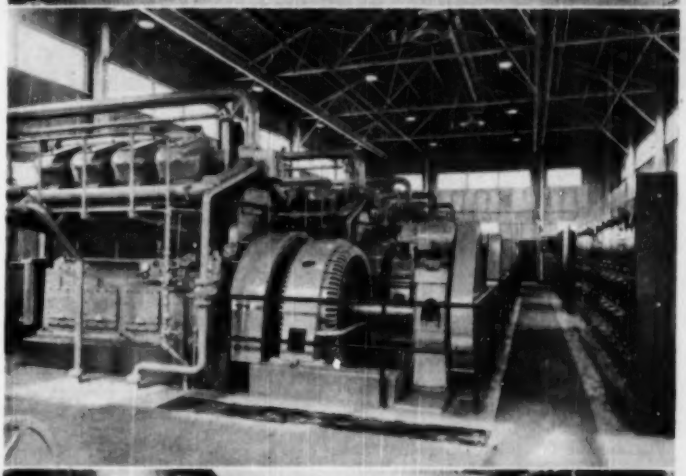


Left—There are six 427 horsepower boilers in the plant. The two new boilers are in the foreground.

Upper Right—Interior of new compressor building which houses eight 800 horsepower compressors. The engine jacket water pumps are in the foreground.



Center Right—The new power plant consists of five 510 kw., 2400 volt generators driven by 800 horsepower, eight cylinder gas engines.



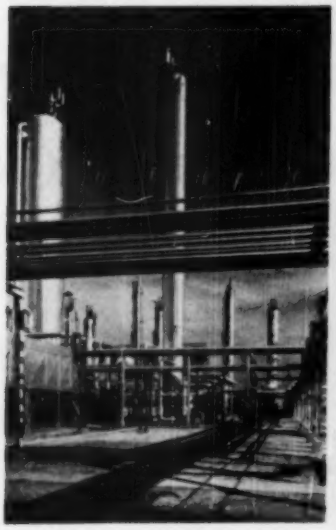
Bottom right—Process pumphouse. The lean oil pumps have a capacity of 1100 gallons per minute and are driven by 250 horsepower, 2400 volt electric motors.

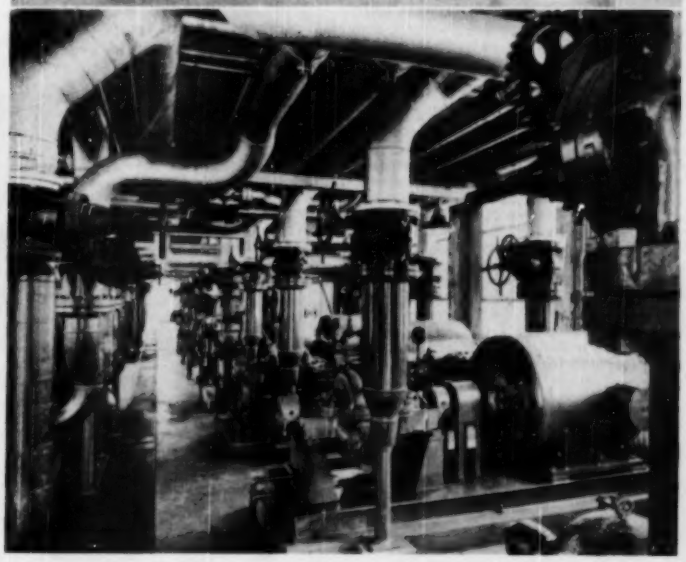
two 80 million Btu. per hour direct-fired rich oil furnaces, and product storage. A dethanizer was added to the first unit, which previously produced a 40-pound gasoline.

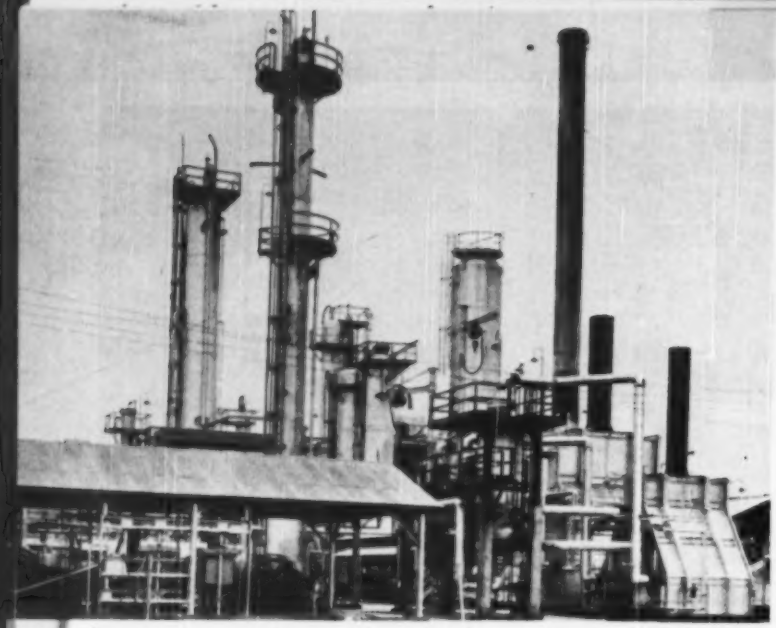
Revision of the process included maximum utilization of the existing equipment. As a result, in the new unit, the process provides for deethanization of the rich oil from the absorbers before it is charged to the still. In the first unit, raw product from the low pressure still is deethanized. Rich oil deethanizing eliminated the need for the two still system as used in the first unit. The rich oil deethanizer is 48 inches by 120 inches by 125 feet. It has 49 trays and is operated at 160 psi.

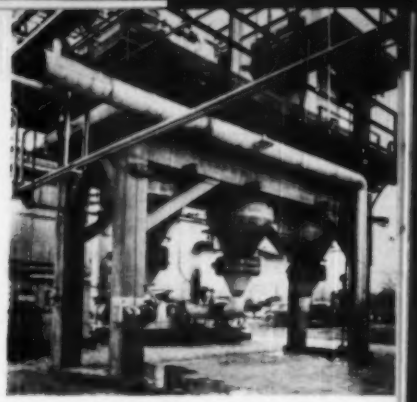
Construction of the plant was by Fluor Corporation, Ltd., Los Angeles, under the supervision of the gas-engineering section of Shell.

Below—View through the plant which shows both the new and old distillation sections. The still and new depropanizer are in the foreground, new deethanizer in the right background.









Above—The platformer reactor battery consists of small first and second stage reaction vessels each containing 25 percent of the total catalyst inventory, and a larger third stage reactor that contains 50 percent of the catalyst.

Upper left—Platforming unit at Old Dutch Refinery in the foreground. Recycle gas compressors, motor driven, are under the shelter roof. The two towers at the left center are respectively the prefractionator and the gasoline stabilizer. Three reactors are at the right center on a concrete support structure. The three heaters just behind and to the left of the reactors serve the platforming unit. The pump house is on the extreme left. The balance of the towers in the right center background, the tall stack, and the heater on the extreme right are used in crude distillation and thermal cracking service, not part of the platforming unit.

Catalytic Reforming at Muskegon Refinery

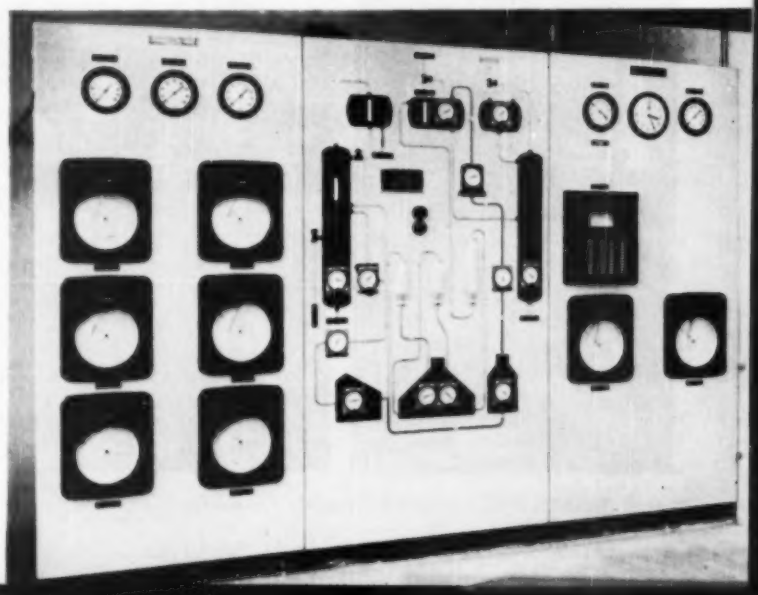
AN ENTIRELY new catalytic process for improving straight-run naphthas and gasolines has been in full commercial operation since October, 1949, at the Old Dutch Refining Company at Muskegon, Mich. The new process, "Platforming," is a development of the Universal Oil Products Company, Chicago.

At this plant a heavy Michigan naphtha of 51-52 clear F-1 octane number is upgraded to 80+ clear F-1 octane number, the product reaching 93+ F-1 octane number with the addition of 3 cc. TEL. Yield at this improvement level is 92-94 volume percent.

While it is much too early to evaluate the ultimate effect of the process upon refinery practice in general, experience with this first unit has been satisfactory and the process has been clearly demonstrated to be operable. Economics will control the application of the process to further plants.

Potential benefits from the process are high for typical applications, and it seems certain that most plant operators will be interested in studying its

The graphic panel control board has indicating instruments arranged on a process flow diagram to show the principal operating variables and recording instruments to maintain permanent records for bookkeeping and process control needs. The three dials at the top of the left panel indicate pressures of fuel gas, cooling water, and refinery air. The temperature recorders below are used on the naphtha heater outlet, recycle gas heater outlet, stablizer reboiler, prefractionator reboiler, No. 2 reactor inlet, and No. 3 reactor inlet. Instruments on the right panel show instrument air pressure, the time, plant steam pressure, miscellaneous plant temperatures on the multipoint potentiometer, flows of reactor charge and of recycle gas, and pressures of recycle gas compressor suction and discharge and of stabilizer overhead. A new flowmeter has since been added on this panel to record the flows of prefractionator charge, reflux, and net overhead. The instruments on the center panel flow diagram show liquid levels in reflux drums, product accumulator, and prefractionator sidestream drawoff tray, flows of process streams, heater temperatures, tower temperatures, and so on.



Performance Data Old Dutch Platforming Unit

Hours on Catalyst	1681—1701			1961—2057		
Average Reactor Pressure, psig.	730			730		
Average Reactor Temperature, °F.	880			890		
Observed Rates and Yields	**B D**	**Vol. Percent of Charge**		**B D**	**Vol. Percent of Charge**	
Reactor Charge	900	100.0		1533	100	
Stabilized Platformate	850	94.4		1420	92.6	
Calculated 10 Lb. RVP Platformate		**Vol. Percent of Charge**			**Vol. Percent of Charge**	
Yield		97.3			97.1	
Outside Butane Required		2.9			4.5	
	Reactor Charge	**Stabilized Platformate**	**Calculated 10 Lb. RVP Platformate**	**Reactor Charge**	**Stabilized Platformate**	**Calculated 10 Lb. RVP Platformate**
Inspection						
API	59.5	60.4	61.7	58.1	57.4	59.7
RVP	2.5	8.1	10.0	2.0	6.9	10.0
Percent Sulfur	0.031 (Turbidimetric)	0.003 (Turbidimetric)	.....	0.08 (Lamp)	0.0019 (Turbidimetric)	
Octane Numbers						
F-1 Clear	51.9	79.1	79.9	52.5	81.3	81.9
+ 3 cc. TEL	71.4	93.1	93.6	70.2	93.9	94.7
F-2 Clear	48.3	75.8	76.7	48.9	75.5	76.1
+ 3 cc. TEL	70.2	87.6	88.3	68.5	87.4	88.2
ASTM Distillation						
IBP	160	103		166	110	
10	196	148		203	135	
30	217	184		225	195	
50	239	214		248	225	
70	266	246		273	260	
90	304	297		309	308	
EP	340	350		355	383	
Reactor Product Component Yields						
H_2 (SCF/BBL.)	330			401		
C_1 (SCF/BBL.)	66			80		
C_2 (SCF/BBL.)	48			53		
C_3 (SCF/BBL.)	55			65		
iC_4 (VOL. PERCENT)	1.3			2.1		
nC_4 (VOL. PERCENT)	5.4			3.3		
iC_5 (VOL. PERCENT)	5.1			5.0		
nC_5 (VOL. PERCENT)	3.5			2.9		
C_6+ (VOL. PERCENT)	80.2			80.2		

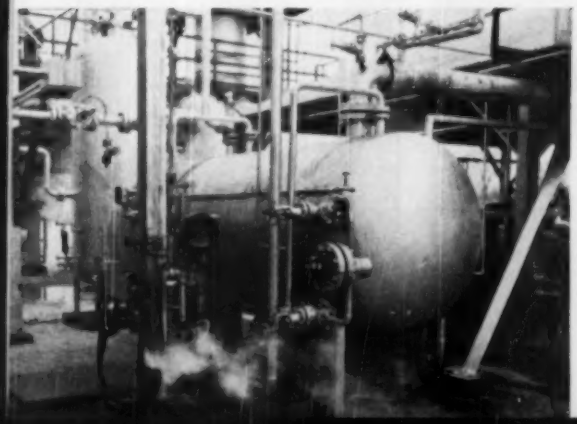
adaptability to their own particular plants and feeds.

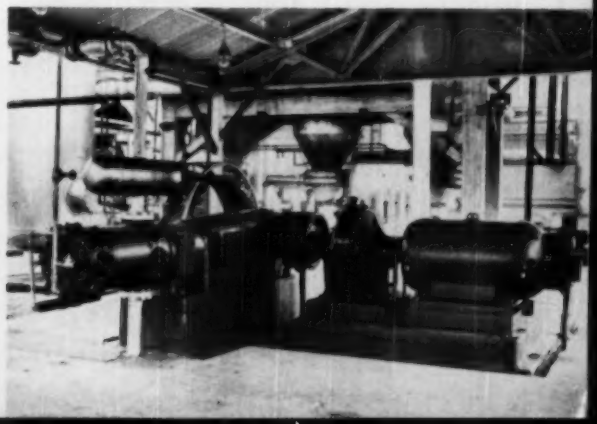
The process utilizes a catalyst which is arranged in a series of fixed bed reactors. Unlike other catalytic reforming processes for naphtha improvement, however, this catalyst does not require frequent regeneration. There is little if any deposition of coke and no provision for catalyst regeneration in place in the reactor beds. Instead, the catalytic reactions of the naphtha conversion are continued for as long as the unit is on stream. Experience to date indicates that shutdowns will be required primarily for equipment inspection. It is anticipated, on the basis of pilot plant experience, that the catalyst will require reworking at intervals, but there is as yet no indication of catalyst deactivation in the unit at Muskegon.

The basic process flow is quite direct, and the absence of accessory equipment for catalyst regeneration gives the plant an over-all appearance more like that of a distillation process than a catalytic conversion process.

As will be noted on the flow diagram, gasoline or straight-run naphtha is fractionated as a sidestream from a feed preparation column to insure a uniform feed stock to the process. This feed, heated to the range 850-900° F. in exchangers and a fired heater, is mixed with a hydrogen-rich recycle stream also at this same temperature level and then flows into a first stage reactor. The reactor effluent is re-

Lower left—Raw product accumulator. Reactor effluent is separated into vapor and liquid components here. The vapor includes recycle gas and make gas from the reactions. It has a hydrogen concentration of 80 plus percent. Temperature here is about 100°F. and pressure 650 psig. Liquid is routed to product stabilization. Lower right—One of the two recycle gas compressors. Reactor outlets in the background.





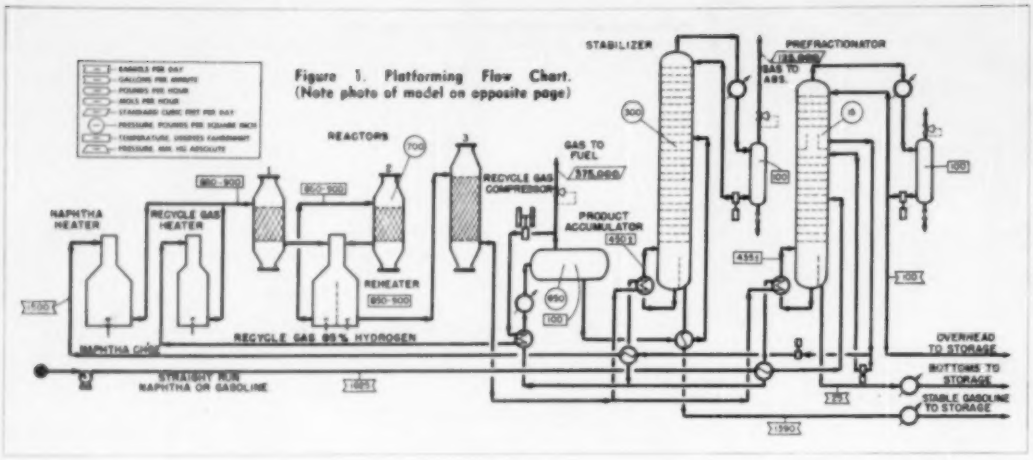


Figure 1. Platforming Flow Chart. (Note photo of model on opposite page)

heated in a furnace coil and then enters a second-stage reactor. Again reheated, this material enters a third-stage reactor. Here there is a near balance between exothermic and endothermic reactions and an exit temperature substantially the same as the inlet temperature is the result. Effluent from this final reactor flows through heat exchange which serves to reboil tower bottoms for the unit and to heat the fresh feed.

The reactor products are finally flashed into an accumulator at some 650 psig. and 100° F. Liquid is withdrawn here and routed to a fractionator where the gasoline yield of the process is stabilized at the desired vapor pressure and then sent on to storage. A stream of hydrogen-rich recycle gas is withdrawn from the product accumulator, compressed to furnace inlet pressure, and routed to a heater where its temperature is raised to the 850-900° F. range. The heated recycle gas is combined with the heated naphtha feed. Excess gas at the product accumulator is routed through pressure control to the plant fuel system, as is the overhead gas production from the plants gasoline stabilizer. These two gas streams constitute the gas production of the process, and are about adequate to supply the fuel needs of the unit.

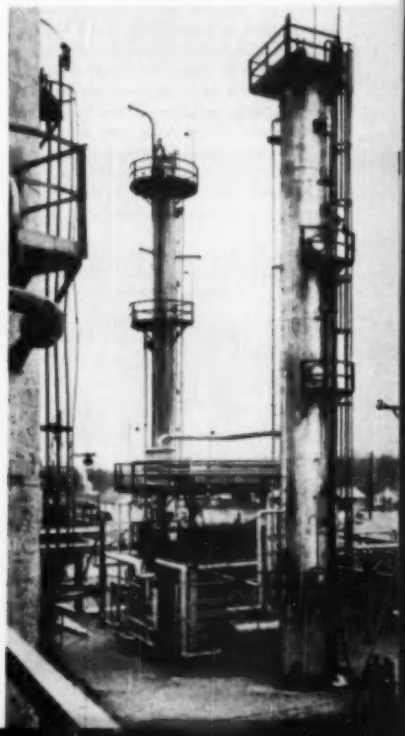
The plant includes a prefractionator, as noted earlier, which serves to set the boiling range of the reactor feed. Since this is its only function it could possibly be eliminated in an installation where a well fractionated naphtha of suitable boiling range could be supplied from existing equipment.

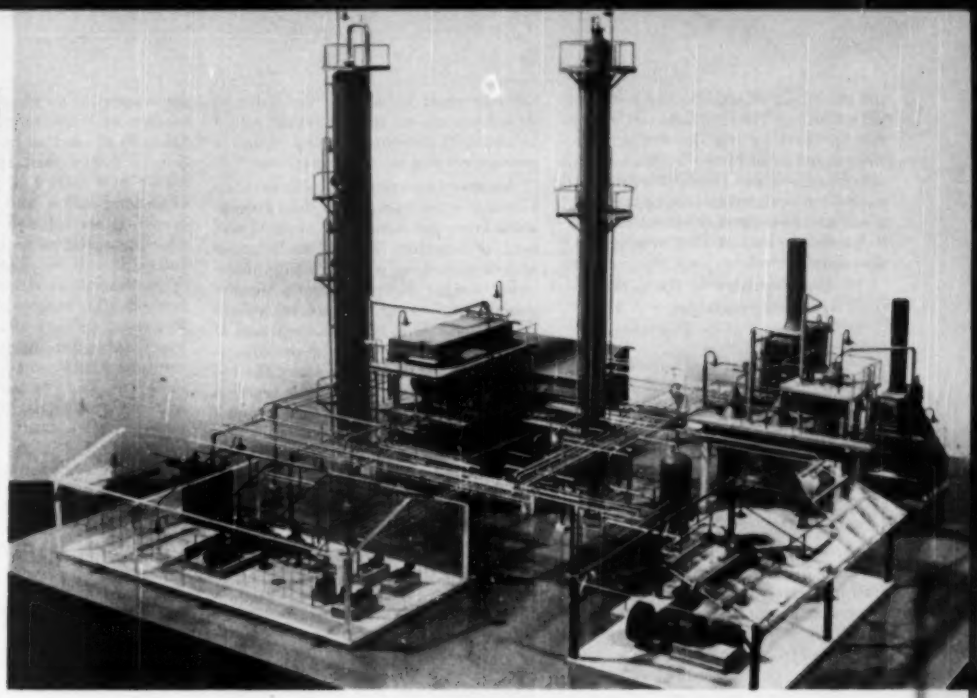
The stabilizer follows conventional practice. The reformed gasoline product contains no appreciable amount of heavy components boiling above the gasoline range, and rerunning of this product is not required. Stream inspections for typical operations are given on page 129.

An interesting detail of the installation is the use of a graphic panel type control board. On this board indicators serve to report the operating variables on a plant flow sheet, while permanent records are maintained by a group of conventional recording instruments.

The men actively guiding the operation of the first commercial platforming unit are, left, G. M. Sharum, superintendent of the Old Dutch Refining Company, and Carl Everson, UOP representative.

The tower in the foreground is the prefractionator, the one in the background the stabilizer. All condensers, coolers, heat exchangers, and receivers, except the product accumulator, are to be seen here.





Model of Old Dutch Platforming Unit Located at Muskegon, Mich. Left to right: Control Room and Pump House, Prefractionating Column, Heat Exchangers and Naphtha Heater and Product Stabilizer Column. Right foreground to right rear: Recycle Gas Compressors, Three Reactors and Intermediate Heaters. (Note flow chart on opposite page.)

PLATFORMING

VLADIMIR HAENSEL
Universal Oil Products Company, Chicago

AT THE 1949 WPRA annual meeting, announcement was made of a new process for improving straight-run or natural gasoline, a process called "Platforming," which represents the reforming of gasolines in the presence of hydrogen using a platinum catalyst.

It is well known that there are tremendous quantities of straight-run and natural gasoline stocks which are becoming less and less marketable because of their low octane number. The realization of this situation is not a sudden one, and the petroleum industry has been extremely active in attempting to convert these stocks into a suitable motor fuel. A tremendous amount of work has been done on noncatalytic processes such as thermal reforming and on catalytic processes such as hydroforming and desulfurization. Although the thermal and catalytic processes have come into commercial application, they do not provide an ultimate solution for the production of high yields of high octane motor fuel from the straight-run and natural gasoline stocks.

This article was presented at the recent San Antonio meeting of the Western Petroleum Refiner's Association.

THROUGH research on the conversion of straight-run and natural gasoline stocks into more valuable products, fundamental ideas were formulated by the U.O.P. organization which outlined the ultimate goal. First, it was realized that the process should be a catalytic one, free, as much as possible, from undesirable thermal effects. The reason for this is that thermal treatment or a high temperature, high-pressure treatment in the absence of catalysts gives rise to reactions which are difficult to control and as a result a large portion of the liquid charge is converted into waste gas. Next, it was realized that such a catalytic process had to be made up of a number of chemical reactions since gasolines contain different hydrocarbon classes, each class requiring a different chemical reaction so that the members of this class can most efficiently be converted into more valuable components. Further, it became apparent that the rearrangement and conversion of the charging stock had to be extensive because there is no simple method of separating the products of the reaction from the charging stock.

Having established the fundamental principles of such an idealized process, it was necessary to find a catalyst which could perform all these functions and also have this extremely important feature: The elimination of the need for catalyst regeneration, a costly and complicated operation. No charging stock is processed over a catalyst during regeneration. The efficiency of a nonregenerative operation and its inherent simplicity provides a practical solution for a refiner who cannot afford a large investment in a plant that remains nonproductive for a good share of the time.

Over the past years, we have found that the Platforming operation approaches closely the ideal solution for

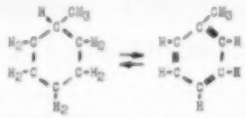
the reforming of straight-run and natural gasolines. The functions of the catalyst in carrying out the desired reactions under conditions wherein wasteful side reactions are virtually eliminated have been realized in laboratory, pilot plant and commercial operation.

Various phases of Platforming to be discussed include:

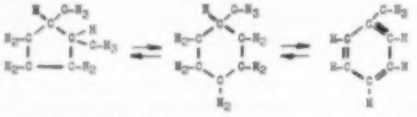
1) The chemistry of the process.
2) Operating variables.
3) Properties of the Platformate.
4) Platforming of mixed straight-run cracked gasolines.
5) Economics of the Platforming process.
6) Operation of the first Platforming unit at Old Dutch Refining Company at Muskegon, Mich.

Chemical Reactions Involved.

Three major reactions occur in Platforming of a straight-run gasoline. The first of these is the dehydrogenation of naphthenic hydrocarbons to the corresponding aromatic hydrocarbons. This is illustrated by the following:

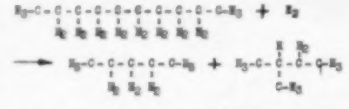


wherein methylcyclohexane is converted to toluene and hydrogen. As is well known, straight-run gasoline contains a substantial amount of naphthenic hydrocarbons, of both the six-membered ring type and the five-membered ring type, and in the latter structure the dehydrogenation reaction is preceded by the isomerization reaction:



Under Platforming conditions the reactions of dehydrogenation of naphthenic hydrocarbons are very rapid and these reactions contribute substantially to the octane gain and heat of combustion of the gasoline. They are also highly endothermic, that is, they require a high heat input and they result in some volumetric shrinkage since the aromatic product is denser than the parent naphthene. Thus, for example, if the charge consisted of pure methylcyclohexane and if it were all converted to toluene, the theoretical yield of toluene would amount to 8.3 percent by volume of the charge with an octane number increase of about 50 units. The naphthenic content of straight-run gasolines varies considerably, but, assuming an average value of about 40 percent, the maximum volumetric yield due to dehydrogenation to aromatics would be about 93 percent assuming complete conversion and no other reactions.

Another important reaction in Platforming is the opposite of dehydrogenation from the standpoint of yield and heat of reaction. This is the reaction of hydrocracking wherein a high molecular weight hydrocarbon is decomposed into lower molecular weight compounds. This is not the reaction of thermal cracking, where a paraffin is cracked indiscriminately along the hydrocarbon chain, nor is it the reaction of catalytic cracking where the product consists of lower boiling paraffins and olefins. It can be considered as a simultaneous cracking-isomerization-hydrogenation reaction, as shown by the following:

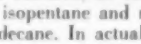
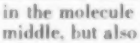
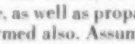
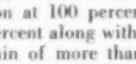
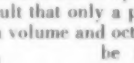


This reaction, as can be seen, produces isopentane and normal pentane from decane. In actual operation, the break in the molecule occurs not only in the middle, but also to the right and left of the center, so that butane and hexane, as well as propane and heptane, are formed also. Assuming for the time being that two pentane molecules are formed, the volumetric yield of such a reaction at 100 percent conversion is 118 percent along with an octane number gain of more than 100 units. As stated before, there is a small loss to propane and lower hydrocarbons with the result that only a part of that high gain in volume and octane number can be realized. It is, therefore, apparent that the hydrocracking reaction balances the dehydrogenation reaction in that it provides for a lower density product and absorbs a part of the hydrogen which is liberated in the dehydrogenation reaction. The reaction is also exothermic and, therefore, provides some of the heat of reaction required for the dehydrogenation step. The hydrocracking reaction is less rapid than the dehydrogenation reaction as will appear from data to be presented in the next section.

Isomerization

The third major reaction in Platforming is isomerization. This reaction was mentioned earlier, when it was stated that five-membered ring naphthenes undergo isomerization to six-membered ring naphthenes prior to the conversion into aromatics. Likewise, the isomerization of paraffins proceeds readily at Platforming conditions. In the case of normal heptane, this reaction is faster than hydrocracking as shown by Figure 1 in which the extent of isomerization and that of hydrocracking are plotted against contact time measured as reciprocal space velocity. It will be observed that as the space velocity is reduced the extent of isomerization reaches a maximum value at a space velocity of about 5. At lower space velocities the hydrocracking of the isomerized compounds reduces the net yield. The composition of the isomerized product is of interest in that nearly every possible heptane isomer is produced. Thus, at a space velocity of six, the composition of the heptane fraction exclusive of the normal heptane charged is as shown in Table 1.

TABLE 1

Compound	Percent in C_7 cut, exclusive of nC_7H_{16}
	46.2
	30.6
	10.9
	4.7
	4.5
	3.1

The hydrocracking reaction which accompanies the isomerization reaction of heptane gives, as expected, propane and butane as the major products, the isobutane-normal butane ratio in the butane fraction being about one. Both higher and lower paraffins, also undergo extensive isomerization.

In addition to the three major reactions that occur in Platforming, there are other important reactions. These include dehydrocyclization, wherein paraffins are converted directly to aromatics, and desulfurization, wherein virtually all of the combined sulfur is converted to hydrogen sulfide.

The question arises as to how we balance the extent of the various reactions that take place in Platforming in order to attain the optimum yield octane relationship. This is accomplished primarily by proper selection and preparation of catalyst. Secondarily, the operating

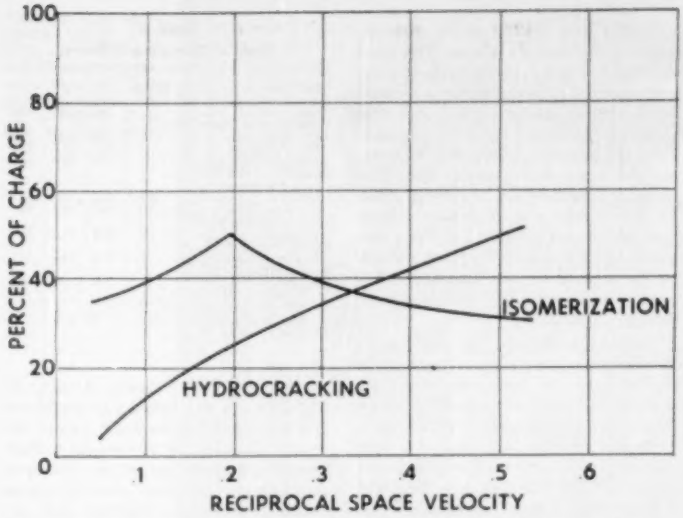


Figure 1. Treatment of Normal Heptane with Platforming Catalyst in the Presence of Hydrogen.

conditions are adjusted to give the desired product distribution.

It should be emphasized that Platforming is unique among reforming processes from the standpoint of low methane production. In a process of this kind, methane production is undesirable from the standpoint of severe loss of liquid product, high exothermicity of the reaction which forms methane and high hydrogen consumption. The extremely low methane production is beneficial on the basis of high liquid yield and control of the reaction at all times. For example, with other catalysts, a high-pressure condition leads to excessive methane formation and an exothermic condition is reached which is difficult to control. With the Platforming catalyst, on the other hand, a high-pressure operation gives only a small amount of methane and as the temperature is increased the selective hydrocracking reaction is quenched by the dehydrogenation reaction. Thus, there is no tendency to develop runaway temperatures in the operation of the Platforming process. In addition it should be pointed out that another undesirable reaction, characteristic of some reforming processes, and involving the formation of high molecular weight compounds, is essentially eliminated in Platforming. Therefore, Platformates do note require rerunning.

Operating Variables

There are four major operating variables in Platforming. These are temperature, space velocity, which represents barrels of charge per hour divided by barrels of catalyst, pressure and hydrogen recycle rate. Over the past few years we have obtained a considerable amount of information both in the laboratory and in pilot plant operation concerning these variables with a number of commercial gasolines and pure compounds as charging stocks. The study of these variables as well as that of catalyst composition has been carried out in eleven laboratory and pilot plant units, ranging in thruput from one gallon to four barrels per day.

As might be expected, the relationships between these operating variables are extremely complex and it would not be practical in this paper to discuss the many details which are necessary to obtain a satisfactory correlation of operating conditions. We can only show certain illustrative effects of major variables but it should be pointed out that these effects are influenced to a considerable degree by the particular type of charging stock and the values of the other variables employed. When a major variable is changed it usually is necessary to make an adjustment in the other variables to obtain optimum performance, that is, optimum performance from the standpoint of yield-octane number relationship as well as from the standpoint of catalyst life.

These factors must be kept in mind when examining the data presented in the discussion.

Table 2 shows the results obtained in processing an initial boiling point to 350° F. boiling range straight-run stock from mixed paraffinic and naphthenic crudes.

The results shown indicate first of all

Figure 2. Effect of Space Velocity.

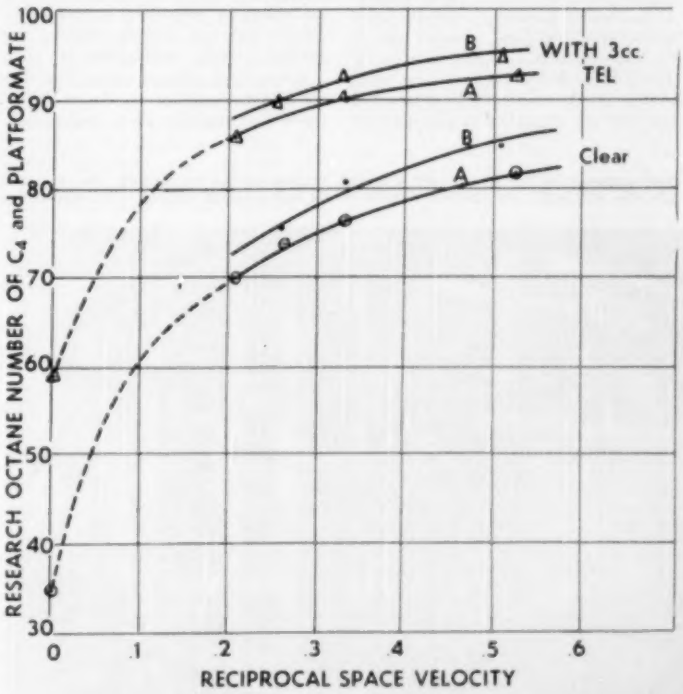


TABLE 2
Effect of Temperature

RUN	Charge	1	2	3	4
Avge. Cat. Temp. °F.	....	813	843	873	903
Yield of C_5+, Liq. Liquid Volume percent of Charge	100.0	96.0	96.8	95.0	91.6
RVP	5.5	5.0	6.7	8.3	11.4
Octane Numbers:					
F-1 Clear	69.5	67.5	74	80.5	89
F-1 + 3 cc. TEL	80.2	85	93	92.5	98.5
F-2 Clear	69.7	65	70	75.5	83
F-2 + 3 cc. TEL	80.0	82	88	88	91.5
Percent Aromatics in Product	9	19	27	33	45
Percent Over @ 212° F.	31	34	36	41	46
Hydrogen Production, cu. ft./bbl.	....	166	318	420	466

that Platforming is a relatively low temperature operation, and it is through the use of these mild conditions that the reaction remains a truly catalytic one, with no interference from undesirable thermal effects. The results also show the increase in the aromatization reaction as well as in hydrocracking with increased temperature at the operating conditions employed. Since both reactions contribute largely to the octane number gain it is not surprising that high octane numbers can be realized.

The effect of pressure as the major variable has been investigated and typical results are shown in Table 3. The charging stock consisted of a 247-404° F. Midcontinent straight-run naphtha. It will be observed that a low pressure operation produced the most aromatics and the least amount of hydrocracking. At the highest operating pressure shown in the table, 900 psig., a larger part of the improvement in octane number is due to the hydrocracking reaction, since in this case the amount of hydrocracked material (as measured by percent over at 212° F.) is almost twice that obtained at the lowest pressure. The yield of butane is large at the highest pressure and in this particular case a small butane excess was obtained over that required for 10-pound RVP gasoline. Thus, it becomes apparent that by varying the operating pressure the Platforming operation can be carried out to produce either a more aromatic gasoline, which means more hydrogen production and a gasoline of lower volatility, or a more volatile product with a lower aromatic content and lower hydrogen production.

The range of pressure used in the Platforming operation is limited at the higher value by economic considerations as well as by temperature required to produce a given quality Platformate.

As the pressure is increased a limit is reached where thermal reactions may occur to such a degree that the yield-octane relationship deteriorates. The lower pressure limit is set by the decrease in the desired amount of hydrocracking as well as by possible carbonization of the catalyst. The lack of carbon formation in the Platforming operation is due to the continuous prevention of formation of materials which lead to carbon, this prevention being carried out by hydrogen. If the partial pressure of hydrogen is maintained at a low value over prolonged periods of time there is a tendency for carbon formation to occur. Such a condition is prevented by providing a reasonable recycle gas rate thereby making the process a truly nonregenerative one.

It has been pointed out earlier that the dehydrogenation reaction is a relatively fast reaction while hydrocracking is considerably slower. A study of the effect of space velocity substantiates this statement. Tables 4 and 5 show the results obtained in processing a Mid-Continent naphtha at various conditions in which space velocity was a principal variable. It will be observed that, according to Table 4, a change in space velocity from about 5 to 2 increased the extent of hydrocracking three-fold (as measured by percent over at 212° F.), while the aromatization reaction, already very extensive at the highest space velocity, was affected only slightly. The results obtained with a somewhat more active catalyst are shown in Table 5 (in this series) where a higher octane number is reached at the same operating conditions. These results are also summarized in Figure 2 correlating the research octane numbers and reciprocal space velocity.

The discussion of the effect of operat-

TABLE 3
Effect of Operating Pressure

RUN No.	Charge	1	2	3
Pressure, psig.	....	500	700	900
Yields, Vol. % of Charge:				
C_5+ Platformate	....	92.6	92.9	93.2
C_5+ Platformate	....	86.5	86.1	83.5
10 lb. RVP Platformate†	....	97.3	96.4	92.4
Octane No. of 10 lb. RVP Platformate				
F-1 Clear	70.6	85.1	84.1	84.8
F-1 + 3 cc. TEL	82.6	98.2	94.3	94.9
Percent Aromatics, based on Charge	7.1	53.9	47.9	45.4
Percent Over @ 212° F. + Loss	0	12.7	18.9	22.7
Hydrogen Production, Cu. Ft./Bbl.	....	685	488	287

† With outside butane 4.7 percent at 500 psig. and 3.5 percent at 700 psig.

TABLE 4
Effect of Space Velocity
Mid-Continent Naphtha 230-395° F.
Catalyst A

TEST No.	Charge	1	2	3	4
Space Velocity*	....	4.9	3.9	3.0	1.9
C_5 + Yield, Volume Percent	....	95.6	95.4	96.1	94.1
RVP	....	4.8	5.2	6.4	6.9
F-1 Clear	35	70	74	76.5	82
F-1 + 3 cc. TEL	59.5	86	89	90.5	93
Percent Aromatics in Product	7	37	39	39.5	41
Percent Over @ 212° F. + Loss	....	8.3	13.5	16	24
H_2 Production, Cu. Ft./Bbl.	....	495	475	470	430

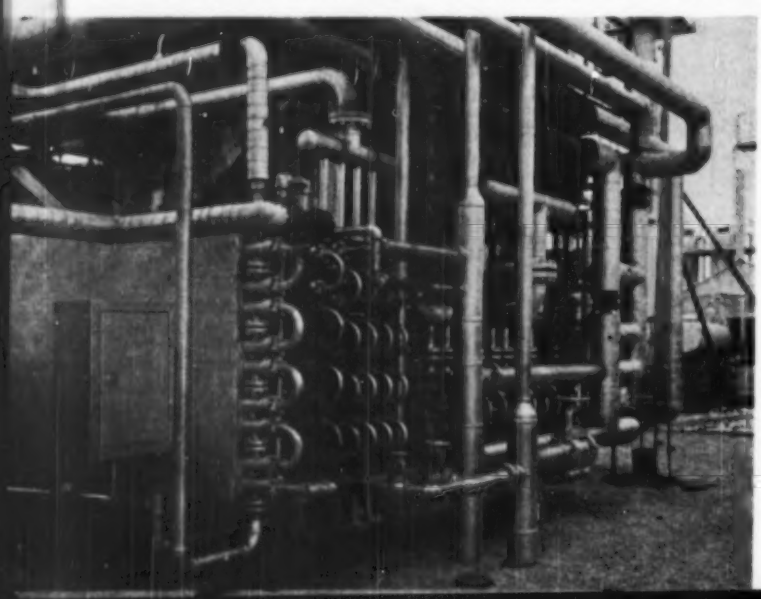
* Barrels charge/hour/barrel catalyst.

TABLE 5
Effect of Space Velocity
Mid-Continent Naphtha 230-395° F.
Catalyst B

TEST No.	1	2	3
Space Velocity*	2.0	3.0	4.0
C_5 + Yield, Volume Percent	91.8	93.9	95.1
RVP	12	10	8.9
F-1 Clear	85	81	78
F-1 + 3 cc. TEL	95	88	90
Percent Aromatics in Product	43	40.5	38
Percent Over @ 212° F. + Loss	32	25	17

* Barrels charge/hour/barrel catalyst.

Heat exchanger battery for the unit is located between the two fractionators. The concentric tube type exchangers are especially suitable for the high pressures involved in this application.



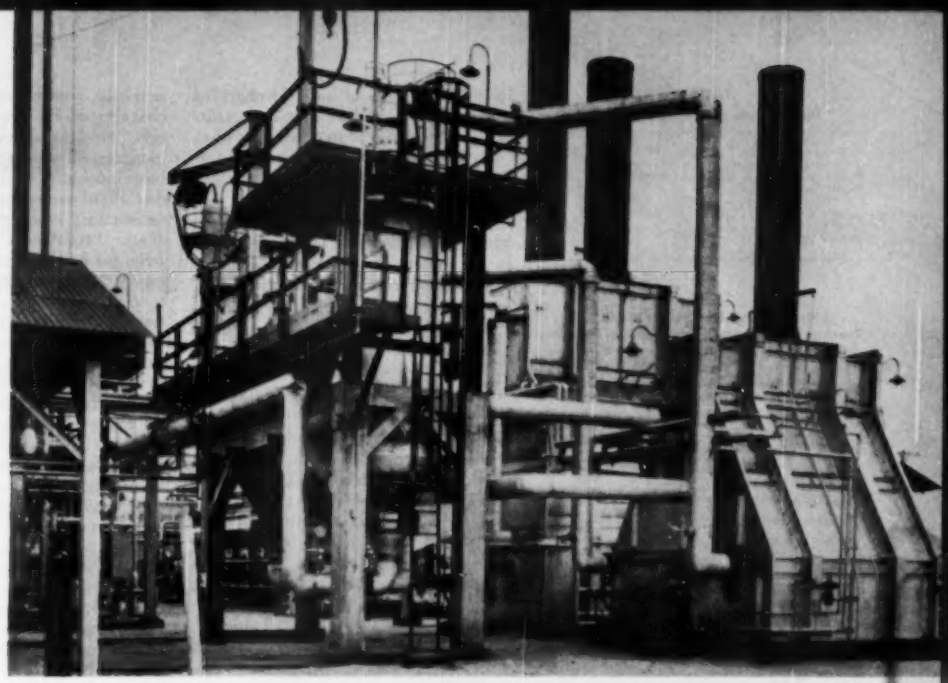


Photo at right shows reactors with No. 3 reactor in foreground and intermediate heater to the right, Platforming unit, Old Dutch Refining Company, Muskegon, Mich.

ing variables brings out also the flexibility of operation. As has been shown, the ratio of the reactions that occur in Platforming can be varied so that it is possible to obtain a number of volatility - octane relationships instead of one single relationship as is true in the case of thermal reforming. This flexibility of operation permits us to produce fuels that have a range of volatilities depending upon the over-all refinery economics.

Properties of the Platformate

The previous discussion has dealt with the product of Platforming from the standpoint of aromatic concentration, volatility and octane number. Other properties of the Platformate are sulfur contents, storage stability, and road performance .

Table 6 shows the sulfur contents of the charging stocks and products and the corresponding leaded research octane numbers at a variety of severities.

The results shown in Table 6 indicate that the sulfur removal from different stocks varies from 88 to 99 percent, the initial sulfur content having no bearing on the extent of desulfurization. In other words, high sulfur stocks are desulfurized to the same extent as low sulfur stocks.

TABLE 6

SOURCE	SULFUR			F-1 + 3 cc TEL
	Charge	Product	Percent Reduction	
Michigan	0.045	0.0027	94	90
Gulf Coast	0.019	0.0023	88	93
Mid-Continent	0.040	0.0042	90	95
California (1)	0.102	0.0005	99	95
California (2)	0.14	0.0036	97	97

A number of storage stability tests have been made on Platformates produced in pilot plant operation. Table 7 is a summary of the storage results using a Platformate from a Michigan stock. The tests were made in vented bottles at 100° F. and no inhibitor was added.

It will be observed that the Platformate is very stable in storage. The addition of inhibitor is required only for the purpose of retaining tetraethyl lead in solution in the same manner as is necessary for straight-run gasoline. A slight drop in color has been observed to occur over the period of storage.

A considerable amount of work has been done by our Automotive and Aircraft Department in connection with the road performance of a variety of Platformates. A discussion dealing with the properties and performance of Platformates is being planned so only brief mention will be made here. It is known that most gasolines have a road performance equivalent to a value between the Research and the Motor octane numbers. It has been found that Platformates have a road performance value which equals or substantially exceeds the Research octane number, the magnitude of this gain being dependent upon the nature of the charging stock and the severity of the Platforming operation.

Platforming of Mixed Straight-Run Cracked Gasolines

The inclusion of an olefin containing material in the charge to a Platforming unit results in the formation of a product similar in quality to that produced from straight-run stocks alone. In view of the fact that the lower boiling fraction of thermally cracked gasoline, that is the material boiling below about 200° F., is a good fuel from the standpoint of octane number, only the higher boiling fraction of thermally cracked gasoline should be included in the charge to the Platformer. The higher boiling fraction from thermally cracked gasolines is, on the other hand, a poor fuel from the standpoint of octane number, sulfur content and storage stability. The conversion of this fraction to a Platformate type of gasoline eliminates all these undesirable properties.

Since olefin containing stocks usually cannot produce as much hydrogen as straight-run gasolines, the processing of cracked gasoline in admixture with straight-run is normally desirable from the standpoint of maintaining a high hydrogen concentration in the recycle gas. The processing of blends contain-

TABLE 7
Storage Stability Tests

	Start	2 Mo.	4 Mo.	6 Mo.	9 Mo.
Peroxide No.	0.1	0.04	0.7	0.8	0.7
Induction Period, Min	>1020				
ASTM Gum	0	1	0	0	1
Color Saybolt	21	17	15	15	15

TABLE 8
Platforming of Cracked Naphtha

RUN No.	Charge	1	2	3
Boiling Range, °F	275–387	133–420	117–420	108–426
Octane Numbers:				
F-1 Clear	60.2	74.9	79.6	89.1
F-1 + 3 cc. TEL	71.8	87.9	91.6	98.0
Percent Sulfur	0.49			0.0045
Bromine Number	20	2	1	1

TABLE 9
Platforming of a 50:50 Blend of Cracked Naphtha and Straight-Run Gasoline

RUN No.	Charge	1	2	3
Boiling Range, °F	102–394	108–407	105–408	88–408
Octane Numbers:				
F-1 Clear	58.9	78.2	84.4	89.9
F-1 + 3 cc. TEL	69.0	90.9	94.5	97.9
Percent Sulfur	0.33		0.0036	

ing equal parts of cracked and straight-run naphthas proceeds very satisfactorily with a substantial hydrogen production.

To illustrate the Platforming of cracked stocks Tables 8 and 9 give the results obtained in processing a West Texas cracked naphtha alone and a blend of equal parts of full-boiling range West Texas straight-run gasoline and cracked naphtha. We have obtained data on the Platforming of a West Texas straight-run gasoline and found that it undergoes a normal upgrading in quality.

The results indicate that thermal gasolines are very susceptible to Platforming and very high octane number fuels have been produced. The reduction in sulfur content should be of interest in a number of refineries where high sulfur crudes produce a high sulfur gasoline on thermal cracking.

We have also investigated the properites of the blend of the Platformed cracked naphtha with the untreated lower boiling fraction of the cracked gasoline. It was found upon comparing the road performance of this blend with the road performance of the original full-boiling range thermal gasoline that the material containing the Platformed fraction was superior to the thermal gasoline by a margin exceeding fifteen octane numbers.

Economics of the Platforming Process

The economics of any process is of course, of major importance to the refiner. It is not proposed here to go into details of the economics of Platforming, but merely to point out the over-all picture.

The exact prediction of the economics of any proposed installation depends on an accurate forecast of the market for and the prices of both the charging stock and the product over the period of the life of the plant, which is obviously impossible. However, certain generalizations, believed to be accurate, can be made:

1) The present trend to emphasize quality will continue. This will result in an increasing differential between the values of charge and of product.

2) The refiner who operates the process which can produce the highest quality product will be best able to survive in a competitive market.

3) The process which has the better yield-octane relationship will have the better economic advantage.

4) As has been shown in data above, Platforming provides for an extremely high volumetric recovery of an exceptionally high quality gasoline produced in a simple unit having a low operating and capital cost.

The operating cost of a Platformer that has a capacity of 1500-2000 barrels per stream day is shown in Table 10:

TABLE 10
Operating Costs for Platforming 1500-2000 BPSD Charge

	Cents per Bbl. Reactor Charge
1. Operator and part time helper per shift	4–5
2. Maintenance	3–5
3. Taxes and Insurance	4–5
4. Utilities	4–5
5. Catalyst	Less than 10
6. Royalty (escalator)	7
Total	20–37

Figures in Table 10 are somewhat conservative. The value given for utilities does not include the fuel gas; however, we do find that the Platforming process is normally self-supporting from the standpoint of the heaters' fuel gas requirements.

Estimates have been made for the cost of Platforming units. These values will vary depending upon the local conditions. Assuming an average labor cost in the Mid-Continent area and all new equipment these values range from about $700,000 for a 1500-barrel per stream day charge to reactors to $1,600,000 for a 5000-barrel per stream day charge and $2,500,000 for a charge of 10,000 barrels per stream day.

Operation of a Commercial Platforming Unit

The first commercial Platforming unit—at the Old Dutch Refining Company at Muskegon, Mich.—was started October 28, 1949, and has been in essentially continuous operation since, charging on the average 900-1000 barrels per stream day of a 180-360° F. naphtha. More recently the thruput has been increased to about 1500 barrels a day. Plant performance has been highly satisfactory and, except for a few mechanical troubles which usually accompany the first try-out of any new equipment, the operation has proved itself to be exceedingly simple. The operation has been conducted at 860-890° F. average catalyst temperature and 700 psig. pressure. The original plan was to operate to obtain a product with a leaded Research octane number of 89-90. However, during the intervening period of construction, which required 139 days, the refiner was called upon to produce a considerably higher octane product. As a result, the unit has been operating at somewhat different conditions to produce a leaded octane level of 93 with a yield of 94.5 percent by volume. At one time the unit was operated for a period of several weeks to produce a Platformate having a leaded octane number of 95.8 with yield of 90 volume percent. The total gas production amounts to about 900,000 cubic feet per day of which more than one-half is vented from the separator and contains 80-85 percent hydrogen. The remaining gas is vented from the stabilizer overhead.

Table 11 gives a typical charge and product analysis from the Old Dutch operation.

TABLE 11
Old Dutch Refining Company Platforming Operation

	Reactor Charge	Product	Reactor Charge	Product
Gravity, °API	56.9	57.6	60.0	62.1
IBP	203	88	178	86
10	220	123	192	129
50	235	240	220	215
90	300	319	302	306
End Point	332	358	334	364
RVP	0.8	13.6		10.0
F-1 O.N. Clear	50	86.1	49	81.3
F-1 + 3 cc. TEL	66.5	95.8	67.5	93.2
Sulfur	0.0450	0.0020		

One of the most significant and important features of the Old Dutch Platforming unit operation is the performance of the catalyst. Over the past four months of operation no indication of any catalyst deactivation has been found and it is expected the catalyst will remain in service for a long time.

ACKNOWLEDGMENT

The development of the Platforming process is the result of intensive work on the part of many in the Universal organization and I should like to express my appreciation to my colleagues for their wholehearted cooperation.

* * *

The Manufacture Of Aliphatic Petroleum Napthas

PART III

H. N. FROST, Chief Chemist
The Pure Oil Company,
Smiths Bluff Refinery,
Nederland, Texas

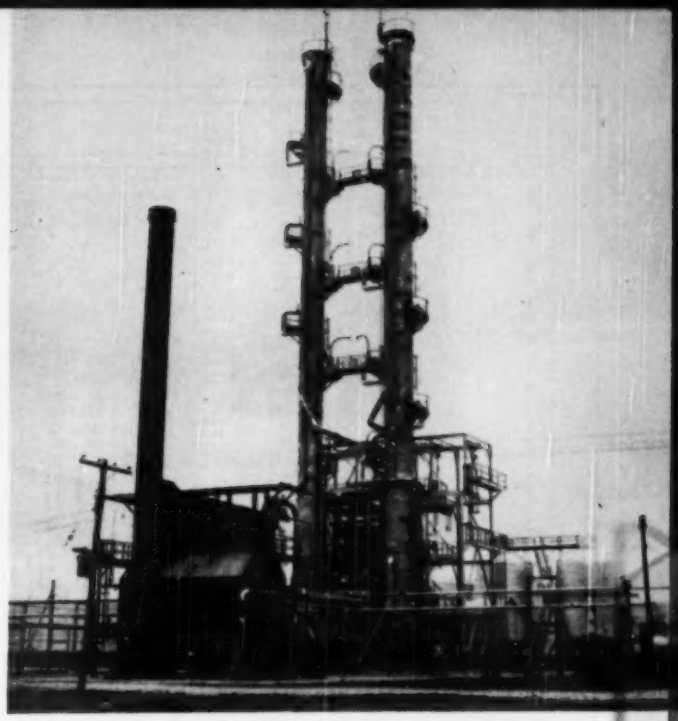


Figure 1. Aliphatic Naphtha Manufacturing Unit

THE Pure Oil Company at its Smiths Bluff, Texas, Refinery recently has completed construction and placed in operation a modern naphtha fractionating unit. The flexibility of this unit, its separating efficiency, and some of the novel operating features incorporated make it worthy of examination and study.

The flow of this unit is shown in Figure 2. Only one finished naphtha fraction is produced at a time and it is taken overhead as a heart cut from the secondary fractionating tower. Of course, the overhead from the primary fractionating tower and/or the bottoms from the secondary fractionating tower may contain desirable naphthas; when this is the case the product streams are run to separate tankage and later charged to the unit to produce the desired specification cut from the top of the second tower. A general description of the unit follows:

IN TWO earlier articles on this general subject the author has outlined the broad uses of aliphatic petroleum naphthas in industry, and has described a laboratory means of evaluating stocks which might be considered for their manufacture. Considered here is the industrial side of this problem, from the refiner's viewpoint, the actual manufacture of these fractions and the equipment required. As has been pointed out before, the market possibilities of these fractions is almost limitless, but to enter this field the refiner must not only be able to meet today's demands, but he must also be prepared for the future when super-fractionated close-boiling hydrocarbons will be, more than likely, the normal requirements of his customers.

Depending on the boiling range desired in the final product the required feed stock is picked up from the charge tank by the primary fractionator charge pump and passed through both the secondary fractionator vapor-feed exchanger and the primary fractionator feed preheater. In the feed preheater the heat exchange medium is gas oil from the circulating heating oil system. Six feed introduction points are shown on this first tower.

The primary tower is 147 feet in height and has 66 bubble trays. The overhead vapor from this tower is condensed in a bank of two condensers, primary fractionator overhead condensers, and the liquid stream flows from there to the primary fractionator reflux accumulator. It is then picked up by the reflux and net yield pump and split into two parts, a portion going to storage and the remainder being returned as reflux. Heat is applied to this tower by the reboiler using oil from the circulating heating oil system.

The bottoms from the primary fractionating tower are picked up by the primary fractionating tower bottoms pump and discharged through the secondary fractionator feed preheater where necessary preheat is again obtained from the circulating oil heating system. The secondary fractionating tower is also provided with six feed inlets for use according to the nature of the operations. This tower is 147 feet in height and has 65 bubble trays. The overhead vapor, the naphtha heart cut, passes through the vapor heat exchanger into the two overhead condensers and then into the reflux accumulator. At this point the liquid stream is picked up by the reflux and net yield pump and split into two parts, a portion going to finished storage and the remainder being returned as reflux. As in the first tower, heat is applied by the reboiler using oil from the circulating heating oil system. Bottoms from the secondary fractionating tower are picked up by the secondary fractionator bottoms pump and sent to storage after first being cooled in the two coolers shown in Figure 1.

Six feed inlets are shown on the primary and on the secondary fractionating towers and these are used according to the nature of the charge stock and the product desired. Actual choice of feed inlets will be dictated by the results obtained during operation; in general, when towers are

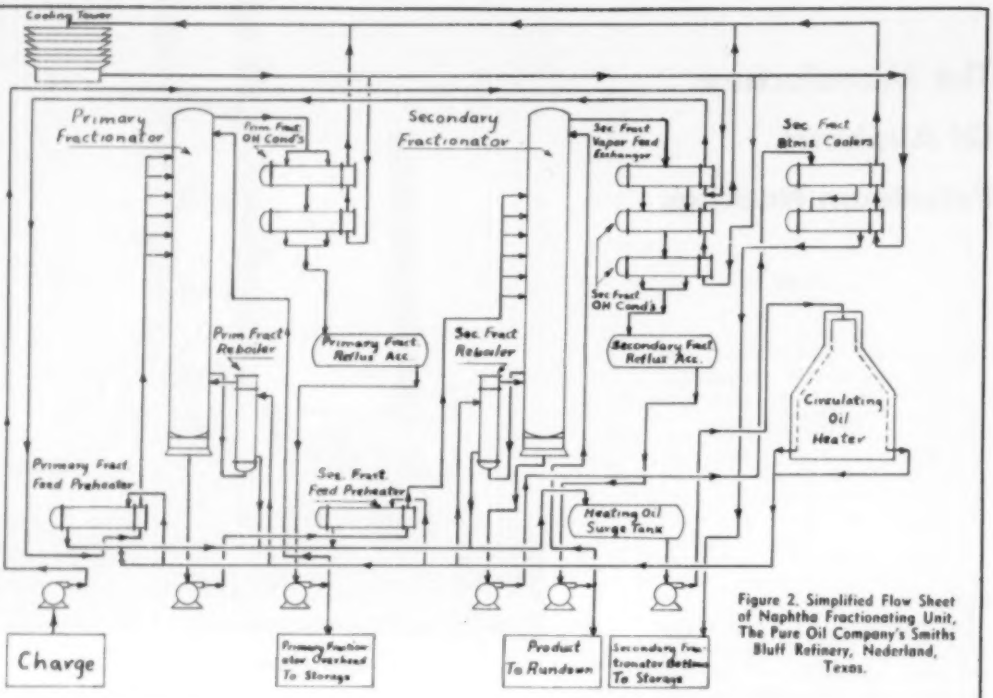


Figure 2. Simplified Flow Sheet of Naphtha Fractionating Unit, The Pure Oil Company's Smiths Bluff Refinery, Nederland, Texas.

equipped with multiple feed inlets, the practice is to put the feed in on the tray where the tower temperature is nearest the feed inlet temperature, but here it will be necessary to consider other factors. For example, during the operation, in order to increase the yield, it may be necessary to move the feed inlet down on the primary fractionating tower and up on the secondary tower; to improve the quality of the product, the reverse is true, that is, raise the feed inlet on the first tower and lower it on the second tower. Since the specifications of the products demand close fractionation it will be seen that the light ends, or low boiling components are taken overhead on the primary fractionator. This in effect determines the initial boiling point and/or flash point of the heart cut, the overhead fraction from the second tower, and the end point of this cut will be established in the secondary fractionator.

All heat supplied to the unit is furnished by means of the circulating heating oil system. In this system, the heating medium—a gas oil having an IBP. and EP. of approximately 500° and 740° respectively—is picked up from the heating oil surge drum by the pump shown and discharged into the circulating oil heater. There the oil is raised to a temperature of approximately 600° F. and discharged into a hot oil supply header. From this header, the heating oil is furnished to the various preheaters and re-boilers as pointed out above. Back pressure on this header is maintained by a pressure controller connecting the hot oil supply and return header. At this point, hot oil not used in heating the reboilers and pre-heaters is bypassed back to the surge drum with the oil that has been used in the exchangers.

A separate induced draft cooling tower is provided to meet the units circulating water requirements. Water from this tower is held at a constant temperature by feeding some of the hot used water into it. This temperature control plus constant flow control to the condensers assures uniform conditions in all of the water fed heat exchange equipment. The three dual condensers through which the water passes are: the primary fractionator overhead condensers, the secondary fractionator overhead condensers, and the secondary fractionator bottoms coolers.

The instruments employed in the control of this unit were installed to facilitate the operation of the tall towers by maintaining constant flow conditions. While it is general practice to control product streams by top tower temperature, this system was not considered advisable, since the temperature differences in the towers under consideration was relatively small and not sensitive enough to the actual conditions in the process. Temperatures obtained on this process are used to bring the unit on stream, and for indications of the general operation, but the flow of products, heat input, heat removal, and reflux is accomplished by flow control. The system of controls as installed and planned for normal operation, presupposes constant feed rates and constant composition. In such a unit where many-tray towers are used with resulting large liquid hold-ups, it is of utmost importance for maximum yields to maintain constant feed conditions. It is desirable to determine by laboratory analysis the quality of the feed before it is charged to the still, so that the product quantities can be anticipated and specification streams produced as soon as possible after the unit goes on stream.

Since flow rather than temperature control is relied on for normal operation and maximum yields two features of this installation are worthy of note. On lines where considerable variation in flow rates are normal in producing the many volatility naphthas two flow regulator valves of different sizes are installed. Then when it is necessary

to greatly increase or decrease the flow, the regulator best suited is employed. Also as mentioned above, flow control is employed to effect the desired rates for the fraction being taken overhead as the heart cut. The installation of special orifice fittings that can be changed under operating conditions allows a variety of orifice sizes for the flow controllers. For each of the lines carrying metered streams of naphtha, heating oil, and cooling water a group of orifice plates are available to allow the operator choice of the one of proper size for the desired range of flow rates. These fittings allow the replacement of the correct size orifice plate with a minimum of delay and without interrupting the line flow.

The charging stocks to this unit are deficient in volatile hydrocarbons (butanes and lighter) consequently to pressure the system the admission of a hydrogen sulfide free natural gas is employed. This gas is introduced into the primary fractionator reflux accumulator and a constant pressure is maintained on this vessel with excess gas being flared if the maximum established pressure is exceeded.

In a unit of this kind, designed to operate as indicated, considerable effort is expended to be sure that the charging stocks are homogeneous and that no tank stratification is present. Motor driven mixers are employed and suitable agitation periods are allowed before the charge tank is cut to the still. Also, if a wide variety of naphthas is to be produced considerable attention must be given to tankage and lines. As is apparent, each closely fractionated cut will require separate tankage and separate filling and loading lines. At the Smiths Bluff Refinery two cone bottom rundown tanks for finished naphthas are employed and these tie into a storage tank manifold with double cocks and bleeder lines. And where either the overhead product from the primary fractionator or the bottoms product from the secondary fractionator is to be saved for future naphtha manufacture care must be exercised to avoid contamination and insure efficient operation.

See Figure 3.

The question of a satisfactory odor is always present and must be watched closely throughout the refining operation. Usually unsatisfactory odor is closely related to sulfur compounds and the chief offenders are hydrogen sulfide and the mercaptans. Without going into the chemistry of hydrogen sulfide removal or mercaptan removal or conversion to disulfides—this has been adequately covered by many authorities — the general methods employed are caustic scrubbing, "doctor," hypochlorite, and acid treatment. Since

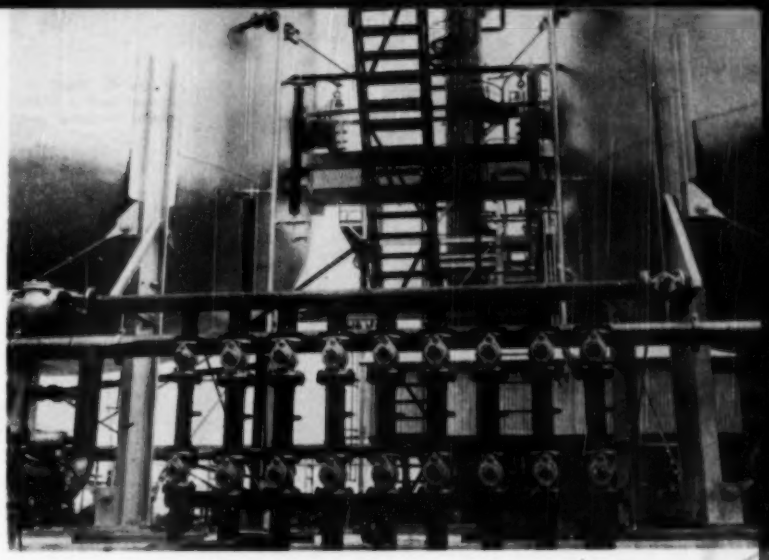


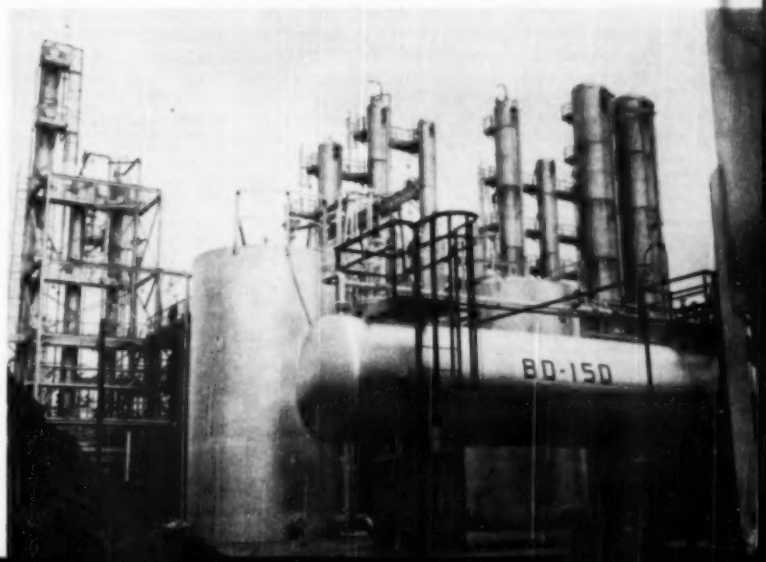
FIGURE 3

the crudes from which the wide boiling range naphtha charging stocks are taken are relatively "sweet," and since the crude still heater temperatures are closely watched to be sure the minimum cracking point is not approached, no acid treatment is required prior to sending these cuts to the naphtha unit. However, before the overhead naphtha still heart cut is pumped to finished storage, a treating step is provided wherein recirculating caustic or sodium hypochlorite finds application. The choice of the treating agent is predetermined from the boiling range of the fraction, laboratory control data, and the final odor of the product; in all cases the product stream going to finished storage is "doctor" negative.

See Figure 4.

In a previous article mention was made that in discussing the operation of the unit some data would be presented to show the relationship between the laboratory control column and the operating still. Since the operators must depend on flow control rather than temperature control to reach and maintain maximum yield conditions, it is mandatory that they know the volume percents of the heart cut as well as the other product withdrawals so that the proper flow regulators and orifice fittings may be selected and used. Of course, routine laboratory distillations serve as a method of control after the operation has stabilized, but the Oldershaw evaluation of the charging stock before the run is started is the key to rapid

FIGURE 4



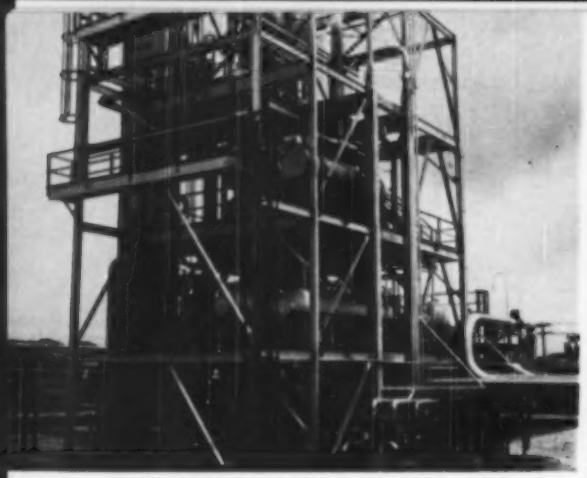


Figure 5. Heat Exchange Section of Aliphatic Naphtha unit.

unit "turnarounds," as well as a check as to how efficient the fractionators are performing.

In this day of narrower margins of profit every means of exacting the last possible percent must be explored. In the figures shown below we see just how closely this unit is meeting or exceeding the yield percentages as established on the laboratory 75-plate Oldershaw column.

The first run was made over a 48-hour period to produce a special Lactol spirits fraction having an initial boiling point of 200° F. and a dry point of 255° F. The second run was also made over a 48-hour period but this time a high-flash mineral spirits naphtha having an initial boiling point of 340° F. and an end point of 400° F. was attempted. All distillations given below are ASTM.

In arriving at the laboratory figures shown in each case above the same identical oil was charged to the Oldershaw column as was charged the naphtha unit, and on which the unit's yields were established. As noticed, the laboratory data was some seven percent greater than actually realized on the unit when the 200°-IBP., 225°-DP. cut was made. This difference was found to be due to the short length of time allotted to this run, a longer run would have increased the heart cut (secondary tower overhead) make. The second run—to produce a 340°-IBP., 400°-EP. Cut—actually saw the unit producing a higher percentage, by some 3.4 percent, than was found in the laboratory.

As will be surmised, if the unit is to produce regular grades of naphthas from fairly uniform charging stocks only one Oldershaw yield evaluation is necessary for each naphtha; yet the laboratory column is beneficial if trouble is encountered or yields are not met, and it is a necessary tool if naphtha specifications or unit charging stocks are changed.

One other feature of this still is its flexibility in changing from one naphtha manufacture to another. It has been found that an average unit "turnaround" can be completed in approximately eight hours, and that when producing high-boiling naphthas a maximum of only 12 hours are required from the time the stream is cut out of finished storage until the unit is meeting the new specifications.

To date only aliphatic naphthas are being produced from this still, yet it is seen from the description that it could easily turn out aromatic solvents if the charging stocks were produced on any of the present catalytic cracking units. While it is reasonable to assume that such an operation would yield lacquer naphthas of extremely high solvency the matter of economics would have to be studied very closely.

This unit has been in operation more than two years as an aliphatic naphtha still. Its operation has been most satisfactory to operators and management alike; and it has clearly demonstrated that it can produce today's naphthas, as well as the close-boiling solvents of tomorrow, regardless of specifications or charging stocks.

IBP. 200° F.—DP. 255° F.

CHARGING STOCK

	Volume Percent Yield	Grav.	IBP.	10%	50%	90%	95%	DP.	EP.	Rec.	Res.	Aniline No.
		62.9	113	165	221	279	290	306	306	98.0	1.0	127.3
Oldershaw Column Run												
Light Overhead Cut	23.00	81.0	100	110	133	150	154	156	163	99.0	0.5	
Heart Cut	40.00	59.3	201	209	220	242	249	253	261	99.0	0.5	125.3
Heavy Bottoms Cut	29.80	50.3	278	284	290	301	308	317	335	98.0	1.0	
Loss	7.20											
Naphtha Still Run												
Primary Tower Overhead	31.00	69.5	98	116	134	159	164	176	184	98	1.0	132.5
Primary Tower Bottoms		56.3	207	220	241	285	297	310	314	98	1.0	
Secondary Tower Overhead	42.00	58.9	200	206	214	233	242	251	254	98	1.0	123.0
Secondary Tower Bottoms	27.03	52.4	268	274	280	298	306	318	318	98	1.0	123.2
Loss	0.00											

* Dry Point.

IBP. 340° F.—EP. 400° F.

CHARGING STOCK

	Volume Percent Yield	Grav.	IBP.	10%	50%	90%	95%	EP.	Rec.	Res.	TCC Flash	Aniline No.
		47.0	309	325	342	414	454	484	98	1.0		133.9
Oldershaw Column Run												
Light Overhead Cut	25.00	52.5	274	288	298	306	308	320	98	1.0		
Heart Cut	64.00	47.7	338	344	352	377	390	401	98	1.0	123°	133.2
Heavy Bottoms Cut	9.10											
Loss	1.90											
Naphtha Still Run												
Primary Tower Overhead	24.00	51.9	278	290	298	306	309	318	98	1.0		128.9
Primary Tower Bottoms		45.8	340	347	361	432	468	490	98	1.0		
Secondary Tower Overhead	67.40	47.0	338	344	350	374	387	401	98	1.0	122°	133.9
Secondary Tower Bottoms	8.80	37.0	452	462	472	502	520	534	98	1.0		147.9
Loss	0.00											

ACKNOWLEDGMENT

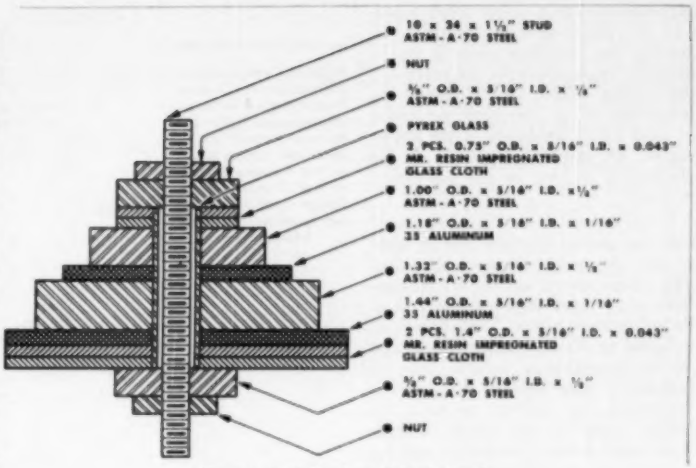
The writer wishes to thank J. Porter Langfitt, Dr. P. S. Nisson, W. E. Norris and C. O. Burch of The Pure Oil Company and E. M. Toby, Jr., and J. A. Bartlett of The American Mineral Spirits Company for their comments, suggestions and help. We specially appreciate The American Mineral Spirits Company's and Mr. Toby's approval to use trade names of products and boiling range specifications.

* * *

SINCE the early development of processes for the removal of acidic constituents such as carbon dioxide and hydrogen sulfide from gases, the problem of corrosion in such installations has disturbed the industry. Although the use of amine solutions improved this situation considerably as compared to earlier methods, severe corrosion was still encountered in plants used to remove carbon dioxide and hydrogen sulfide from flue gas, hydrogen, and refinery and natural gases.

The amine process, which at present is used on a large scale for different gases, employs an aqueous solution of an alkanolmine or a mixture of such an amine, diethylene glycol and water, which is contacted with the gas to be treated and subsequently denuded of its acid gas content by heating to its boiling point.

By such a cyclic operation, the solution can be reused continuously and a treated gas of very high purity with respect to hydrogen sulfide and carbon dioxide is obtained. The details and application of the process have been described adequately elsewhere.[1, 2]


10 x 34 x 1½" STUD
ASTM - A-70 STEEL
NUT
⅛" O.D. x 5/16" I.D. x ⅛"
ASTM - A-70 STEEL
PYREX GLASS
2 PCS. 0.75" O.D. x 5/16" I.D. x 0.043"
MR. RESIN IMPREGNATED
GLASS CLOTH
1.00" O.D. x 5/16" I.D. x ⅛"
ASTM - A-70 STEEL
1.18" O.D. x 5/16" I.D. x 1/16"
33 ALUMINUM
1.32" O.D. x 5/16" I.D. x ⅛"
ASTM - A-70 STEEL
1.44" O.D. x 5/16" I.D. x 1/16"
33 ALUMINUM
2 PCS. 1.4" O.D. x 5/16" I.D. x 0.043"
MR. RESIN IMPREGNATED
GLASS CLOTH
⅝" O.D. x 5/16" I.D. x ⅛"
ASTM - A-70 STEEL
NUT
Figure 1. Steel-Aluminum Galvanic Couple

Corrosion Problems in Gas Purification Units Employing MEA Solutions

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The Fluor Corporation, Ltd., Los Angeles

Theory of Corrosion

In spite of the extensive use of the aqueous and glycol-amine processes during the past two decades, little information is available in the literature concerning the corrosion of metals in such solutions in the presence of acidic gases such as hydrogen sulfide and carbon dioxide. No information at all has been published on glycol-amine solutions or aqueous solutions used in cases where the gas to be treated contains hydrogen sulfide and is free from oxygen. The only information available[7, 8, 9] deals with the corrosion found in systems where carbon dioxide is removed from flue gas and hydrogen which, among other constituents, contain small amounts of oxygen. The work done in these cases had the sole purpose of finding means for preventing corrosion of steel in such systems either by the choice of a non-corrosive amine or by the addition of certain inhibiting agents.

It was observed by the early authors[7, 8, 9] that rather severe corrosion occurred in plants employing aqueous solutions of monoethanolamine for the removal of carbon dioxide from flue gas. Some of these authors[9] found that upon heating, an aqueous monoethanolamine solution, saturated with carbon dioxide, dissolves iron which is precipated in the form of insoluble iron salts as soon as the solution has been stripped of its carbon dioxide content. In general, the prevailing theory was that monoethanolamine becomes oxidized in the presence of small amounts of oxygen and is converted to organic acids such as glycine, glycolic and oxalic acids.[8, 9] These acids, it was assumed, form salts with the iron from the metal surface and thus are the prime agents responsible for the corrosion of the equipment. Certain standards for the "corrosiveness" of solutions were arbitrarily determined, expressed in parts per million of iron dissolved in the solution; and the permissible iron capacity of a solution saturated with carbon dioxide, also expressed in parts per million, was also established. In practice, the permissible limit for iron capacity of an amine solution was set arbitrarily at 1000 parts per million; if this value was reached the solution was classified as corrosive and certain steps had to be taken in order to recondition it for further use. These steps consisted either of adding to the solution a strong inorganic base, such as sodium carbonate, in order to neutralize the organic acid or of employing a semi-continuous steam distillation of the solution in order to separate the volatile monoethanolamine from the less volatile, undesirable oxidation products. It is reported in the literature[5] that corrosion of steel equipment has been prevented successfully by these measures and the theory of the acidic constituents resulting from oxidation of the monoethanolamine being the cause of the corrosion has been widely accepted.

However, it was found in certain instances that solutions having an extremely low iron content and a very low iron capacity caused severe

corrosion in plants using either aqueous or glycol-amine solutions. An attempt was therefore made to find a different explanation for the corrosion phenomena which would present an interpretation of corrosion occurring in cases where oxidation of the amine cannot be assumed, because of the absence of oxygen in the gas being treated.

It is known from the literature[3] that free carbon dioxide, also referred to as "aggressive carbon dioxide," will cause severe corrosion, particularly at elevated temperatures and in the presence of water. The mechanism involved in such systems consists first of the formation of soluble iron bicarbonate upon heating the solution containing the carbon dioxide. On further heating, the carbon dioxide is released from the solution and the soluble iron bicarbonate is converted to insoluble iron carbonate and subsequently, in the presence of oxygen, to hydrated iron oxide. Iron carbonate and hydrated iron oxide, being very insoluble, are precipitated from the solution and thus, upon resaturation with carbon dioxide and heating, the solution is capable of dissolving more iron in the form of bicarbonate which in turn is deposited as carbonate and oxide. It can be seen that such a cycle will cause very rapid corrosion of steel equipment which most probably will be aggravated by galvanic action between the steel surface and the oxide deposits. The presence of hydrogen sulfide in such solutions will in turn aggravate the corrosion since any dissolved iron will be precipitated immediately as insoluble iron sulfide instead of iron carbonate and oxide. This reaction will add to the corrosive attack of hydrogen sulfide on carbon steel which can be expected at elevated temperatures.[4] This explanation of the chemistry of the corrosion in amine systems is based entirely on the action of the acidic gases present and the prevailing temperature conditions. It is not necessary to assume the formation of acidic decomposition products of the monoethanolamine in order to account for very severe corrosion. In fact, as will be discussed below, it was found that amine solutions themselves were non-corrosive toward steel, regardless of the temperature at which they were contacted with the metal. It has been shown, furthermore, that carbon dioxide alone in water corrodes steel very severely,

Figure 3. Comparative Corrosion of Carbon Steel and Alloys in Monoethanolamine-Water and Monoethanolamine-Diethylene Glycol-Water in the Presence of CO_2 at Test Conditions % Weight Loss (Average of two Specimens) vs. Total Contact Time.

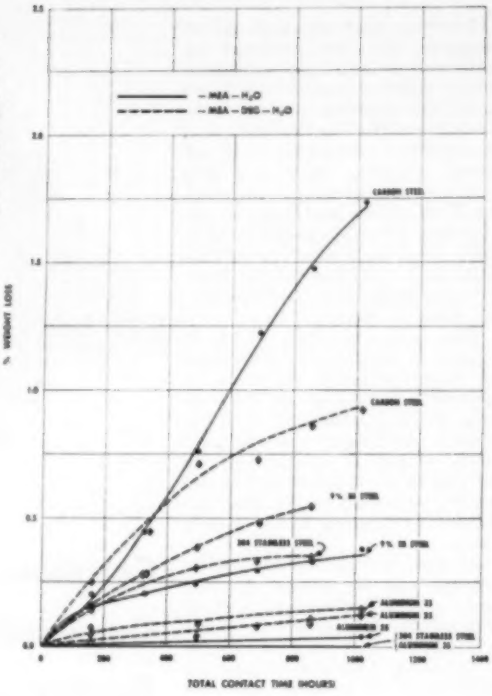
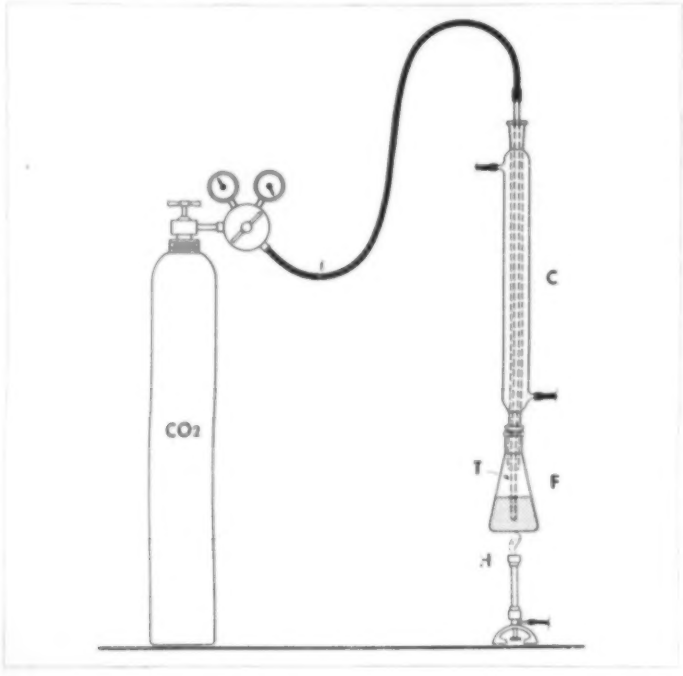


Figure 2. Equipment for Test with Carbon Dioxide



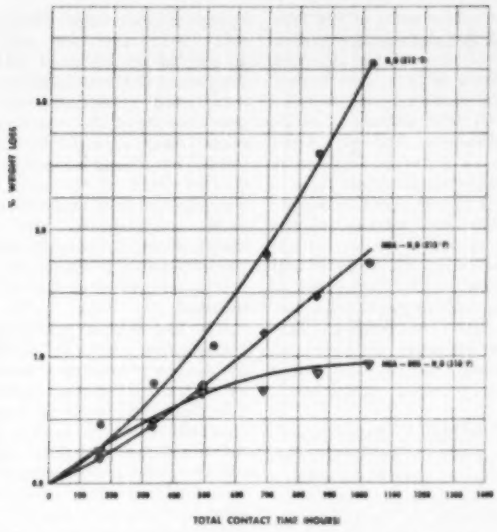


Figure 4. Comparative Corrosion of Carbon Steel in Water, Monoethanolamine-Water and Monoethanolamine-Diethylene Glycol-Water, in the Presence of CO_2 at Test Conditions % Weight Loss (Average of two Specimens) vs. Total Contact Time.

which corrosion is reduced considerably by the presence of amine, and therefore it was concluded that the prime agents for the corrosion of steel observed in gas treating systems are the acidic gases, carbon dioxide and hydrogen sufide.

It is to be understood that the mechanism discussed above is assumed to be the most important factor for the corrosion observed. However, like most other corrosion problems, it is believed that other factors such as electrolytic action between corrosion products and the steel and also between acid gas bubbles and the metal surface as well as concentration cell effects contribute to the over-all picture which is probably of a quite complex nature.

It has been observed that in plants employing aqueous monoethanolamine solutions either for the removal of carbon dioxide from flue gas or of carbon dioxide and hydrogen sulfide from natural gas, the most critical point with respect to corrosion is the reboiler at the bottom of the regenerating still. At this point of the system, the highest temperature prevails and, due to the nature of such systems, a very considerable amount of desorption of acid gas, particularly carbon dioxide, takes place. In glycol-amine systems, most of the corrosion is found in the heat exchangers at the point where the hot, regenerated solution leaving the still is heat exchanged against the acid gas saturated solution flowing to the still. Since the temperature of the regenerated solution leaving the bottom of the still is higher than the temperature of the solution at any point in the still before entering the reboiler, the skin temperature of the heat exchanger tubes in the immediate vicinity of the entry point of the lean solution is higher than at any point in the still column. Since, further, in glycol-amine systems practically all of the stripping is effected in the still column and a substantially acid gas free solution enters the reboiler, the hottest pass in the heat exchanger is the point at which an acid gas saturated solution contacts metal at the highest temperature. It is therefore understandable that corrosion will occur at this point rather than in the reboiler, assuming that the acid gas and the high temperature are solely responsible for the corrosion.

The above comparison between the two systems with respect to the points most susceptible to corrosive attack indicates quite clearly that the presence of acid gas at high temperatures must be considered the prime factor for the observed corrosion. It appears to the writers that if oxidation products of the monoethanolamine, such as organic acids, were primarily responsible for the observed corrosion, both systems, aqueous amine and glycol-amine, should show the severest attack at the same point, or at least in the same general area; namely, the still and reboiler. Field experience has shown, however, that very little corrosion has been found in reboilers and stills of glycol-amine plants except in cases where the regeneration stage was operated improperly and appreciable acid gas stripping was allowed to take place in the reboiler.

Another contributing factor to the corrosion found in amine systems is the presence of acidic constituents other than hydrogen sulfide and carbon dioxide in the gas to be treated. In some instances it was found that the gas, particularly when refinery

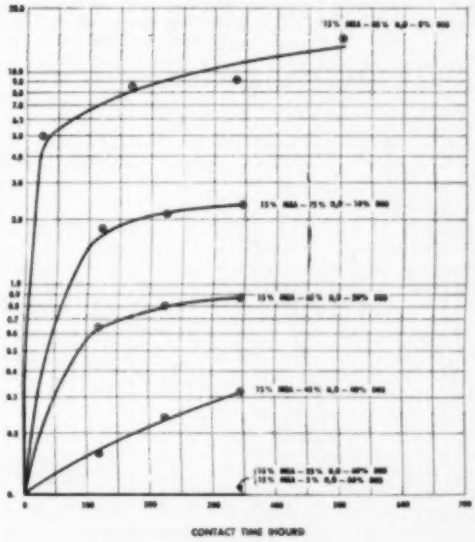


Figure 5. Comparative Corrosion of Aluminum 25 in Monoethanolamine-Water-Diethylene Glycol (MEA-H_2O-DEG) % Weight Loss (Average of two Specimens) vs. Time Temperature = 77° F.

gas was treated, contained small amounts of fatty acids such as formic and acetic acid. These acids not only reacted with the amine, forming compounds which could not be dissociated by heating, but also caused very severe corrosion of practically all parts of the equipment. However, such cases are quite rare and have been coped with successfully by pretreating of the gas for the removal of these constituents.

It appears from experience in the field and from the laboratory experiments, which will be discussed later, that the temperature of the saturated solution is quite critical for the corrosion of steel. This is probably not only due to the known increased corrosivity of carbon dioxide and hydrogen sulfide, particularly in the presence of water and oxygen, at elevated temperatures, but also to the shift in the alkalinity of the solution. The alkalinity of amine solutions decreases with increasing temperature, a phenomenon which makes possible the regeneration of acid gas saturated solutions by boiling. Since the acid gas is released at high temperatures together with an equal or greater volume of steam, it is quite possible that in the hottest regions of the regenerating stage a neutral or even slightly acid condition prevails. This consideration, however, is only applicable in its full extent to systems employing aqueous solutions of amines which behave like electrolytes. However, it is quite probable that condensation of water saturated with carbon dioxide and hydrogen sulfide occurring on colder parts of the heat exchanger of the glycol-amine system is the cause of some of the observed corrosion. Since it is a well known fact that the corrosion of steel increases rapidly with decreasing alkalinity,[6] the change in alkalinity in the hot solution is a further indication that the reboiler is the most vulnerable spot in a system using an amine-water solution. Any increase of the temperature in this reboiler, for instance by increasing the pressure and thus raising of the boiling point of the solution, will aggravate the corrosion of steel considerably. This explains the excessive corrosion of reboilers found in aqueous amine plants using pressure regeneration.

Experimental Procedure

In order to test the validity of the above theory, a simple laboratory experiment was devised, which consisted in principle of the following: An aqueous solution containing approximately 15 percent by weight of monoethanolamine was saturated with carbon dioxide and subsequently boiled in a stream of carbon dioxide in contact with steel turnings for a period of four hours. After that, the carbon dioxide stream was shut off and the solution was stripped of its carbon dioxide by further boiling. As soon as the carbon dioxide was removed from the solution, the appearance of a dark precipitate could be observed. Upon introduction of a small amount of oxygen, the precipitate became very voluminous and showed all the characteristics of hydrated iron oxide. These experiments were conducted with aqueous as well as glycol-amine solutions of the same monoethanolamine concentration and containing fresh commercial and specially purified monoethanolamine in order to exclude the possibility of the presence of oxidation products of the amine. Since it was felt that these preliminary experiments substantiated the proposed theory of the corrosion mechanism, a comprehensive program for the further investigation of the subject was initiated.

The first step in this program was the selection of alloys which, due to their greater resistance to corrosion by carbon dioxide and hydrogen sulfide, could be used as construction materials in certain parts of gas treating plants using aqueous or glycol-amine solutions. These materials were then tested for their corrosion resistance to amine systems containing either carbon dioxide alone or carbon dioxide and hydrogen sulfide.

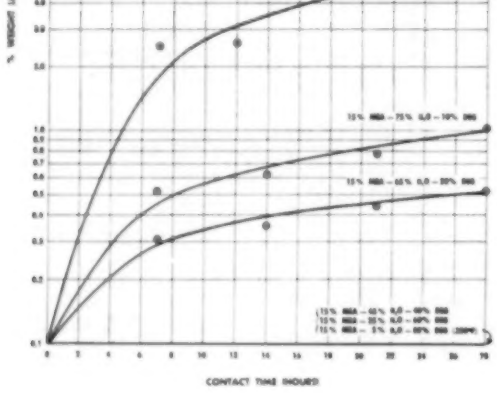
The following materials were finally selected for the investigation:

(1) Carbon steel condenser tubes.
(2) Carbon steel plate.
(3) Stainless steel tubes (18-8, Type 304, Carpenter).
(4) Stainless steel coupons (18-8, Type 304, Timken).
(5) 5 percent nickel steel coupons (Nicloy 5, Babcock and Wilcox).
(6) 9 percent nickel steel coupons (Nicloy 9, Babcock and Wilcox).
(7) 2¼ Cr.-1 Mo. steel coupons (2¼ percent chromium, 1 percent molybdenum, Timken).
(8) 4-6 Cr.-½ Mo. steel coupons (4-6 percent chromium, ½ percent molybdenum, Timken).
(9) Aluminum 2S tubes (Alcoa).
(10) Aluminum 3S tubes (Alcoa).
(11) Aluminum 3S plate (Alcoa).

Small specimens of approximately 1 to 2 square inches total surface were prepared from the above materials. Care was taken to smooth the edges in order to prevent local corrosion due to rough spots. However, the samples were neither polished nor pickled since it was felt that commercially used tubes would not be subjected to such treatment and more representative results could be obtained by preserving the original surface. Galvanic couples were also prepared from carbon steel and aluminum 3S plate stock which are a modification of the couples specified by Sub-Committee 8 of ASTM Committee B3. A sketch of one of these couples is shown in Figure 1.

The amine solutions used were prepared from commercial monoethanolamine and diethylene glycol. All solutions were prepared on a weight basis. The acid gases, hydrogen sulfide and

Figure 6. Comparative Corrosion of Aluminum 2S in Monoethanolamine-Water-Diethylene Glycol (MEA-H_2O-DEG) % Weight Loss (Average of two Specimens) vs. Time
Temperature = 200° F.



carbon dioxide, were also of commercial grade.

In order to study several aspects of the problem, three series of experiments were conducted. Series No. 1 involved contacting of the specimens with the solutions in the presence of carbon dioxide alone, Series No. 2 involved contacting the specimens with the solutions in the presence of carbon dioxide and hydrogen sulfide, and Series No. 3 consisted of contacting the specimens in a dynamic system with a glycol-amine solution containing carbon dioxide and hydrogen sulfide at different degrees of saturation and at different temperatures. Each series of this investigation will be discussed separately describing the actual procedure and the results obtained.

Series No. 1—Corrosion of Carbon Steel and Alloys in Amine Solutions In the Presence of Carbon Dioxide.

Since it was desired to obtain significant results in the shortest possible period of time, it was felt that an accelerated test should be used in this part of the study. Based on the theoretical considerations discussed above, and the preliminary experiments, it was thought that a cyclic operation involving alternate saturation and stripping of the solution with carbon dioxide would cause rather rapid corrosion in a relatively short time interval.

The procedure adopted, therefore, consisted of placing duplicate, accurately weighed and measured specimens in a flask containing the amine solutions in such a manner that the samples were totally immersed. The solutions used consisted of 15 percent monoethanolamine, 85 percent water and 15 percent monoethanolamine, 80 percent diethylene glycol, 5 percent water by weight.

The solutions were saturated with carbon dioxide for a period of 15 minutes, after which time they were heated and refluxed at their boiling point (approximately 215° F. for the aqueous amine and 310° F. for the glycol-amine-water solution) for four hours, always in a stream of carbon dioxide. Heating was then discontinued and the solutions were cooled for one hour while maintaining the stream of carbon dioxide. After that period, the carbon dioxide was shut off and the solutions were stripped of their acid gas content by boiling for three hours. Then the heat was turned off and the solutions were resaturated with carbon dioxide for one hour and left standing over night.

This cyclic operation was repeated five times in seven days, after which period the specimens were removed, cleaned by washing with soap and water and brushing with a nylon brush, dried in acetone, weighed on an analytical balance to an accuracy of 0.1 mg and inspected. Subsequently, the samples were returned to the flasks together with fresh solution and the same operation was repeated six times.

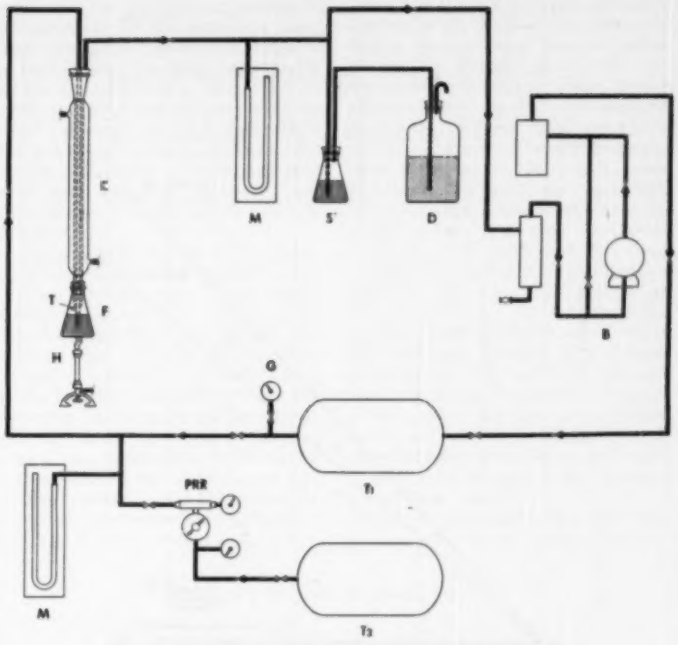


Figure 7. Equipment for Tests with Carbon Dioxide and Hydrogen Sulfide.

In this manner, corrosion rates were determined over a total contact time of approximately 1000 hours consisting of approximately 800 hours in a cold saturated solution, 100 hours in a hot saturated solution and 80 hours in a hot stripped solution. A diagrammatic sketch of the equipment is shown in Figure 2; the results of this phase of the investigation are presented in Figure 3, which is self-explanatory.

It should be pointed out here that the reported rates of corrosion do not represent absolute values, but rather comparisons of the behavior of the various materials under the test conditions. Due to the fact that this cyclic procedure involving three different conditions; namely, contact with a saturated cool, a saturated hot and a stripped hot solution, was adopted, and furthermore that it was found by subsequent work that the rates of corrosion are by no means the same at any one of these three conditions, it becomes obvious that no absolute corrosion rates could be obtained by this procedure. However, it was felt that the wide differences shown by the various materials under these conditions were sufficient to permit segregation of the corrosion resistant materials from those that yielded to the attack.

As can be seen from Figure 3, only carbon steel and 9 percent nickel steel showed appreciable corrosion in aqueous amine solutions in the presence of carbon dioxide. In glycol-amine-water solutions with carbon dioxide, carbon steel and 9 percent nickel steel corroded most, 18-8 stainless steel showed some corrosion, while the two aluminum alloys showed a negligible amount of corrosion. The general appearance of the carbon and 9 percent nickel steels was that of chemical attack over the entire surface. The stainless steel showed slight pitting but otherwise did not change in appearance. No change could be observed in the aluminum alloys.

In order to determine the influence of the amine and also of the glycol on the rate of corrosion of carbon steel by carbon dioxide, three flasks containing an aqueous amine solution, a glycol-amine-water solution, and water, respectively, together with the two carbon steel samples, were subjected to the test procedure outlined. Figure 4 shows the rate of corrosion found in these three media. Inspection

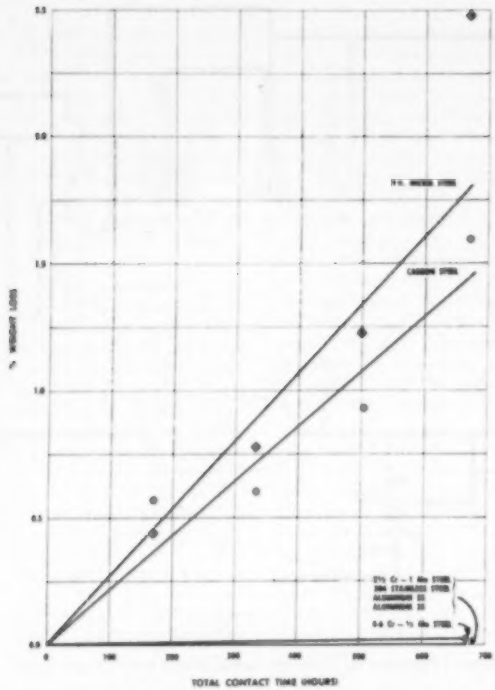


Figure 8. Comparative Corrosion of Carbon Steel and Alloys in Monoethanolamine-Diethylene Glycol-Water in the Presence of CO_2 and H_2S at Test Conditions. % Weight Loss (Average of two Specimens) vs. Total Contact Time.

of this figure demonstrates that the carbon steel corroded most in the water while in the aqueous and the glycol-amine-water solutions the corrosion was about the same. The rate of corrosion was slightly increasing in water, quite constant in the aqueous amine solution and slightly decreasing in the glycol-amine-water solution.

It was felt that these experiments indicate that amine and glycol act somewhat as corrosion inhibitors, which may be due, particularly in the glycol-amine-water solution, to a depression of the water activity and a change in the ionic character of the solution. Considering the fact that the atmospheric boiling point of a 15 percent aqueous amine solution is approximately 215° F. and of a glycol-amine-water solution containing 15 percent monoethanolamine, 80 percent diethylene glycol and 5 percent water about 310° F., and also that the corrosion of steel by carbon dioxide increases with temperature, the corrosion depressing influence of the glycol becomes quite apparent.

One part of this series of experiments consisted of the study of the corrosion of carbon steel and aluminum in aqueous and glycol-amine-water solutions containing no carbon dioxide at room temperature and at the boiling point of the solutions. The results obtained are presented in Table 1. The data show quite conclusively that carbon steel is not subjected to corrosive attack by acid gas free aqueous or glycol-amine-water solutions. The aluminum, however, showed severe attack in aqueous amine solutions, particularly at high temperatures, while glycol-amine-water solutions did not corrode aluminum to any appreciable extent. In order to determine the critical glycol concentration, a series of experiments was conducted with solutions containing a constant amount of monoethanolamine and varying amounts of diethylene glycol and water.

The results of these runs are presented in Figures 5 and 6. It is quite interesting to note that the glycol has a very distinct corrosion depressing effect and that solutions containing 40 percent glycol or more do not appear to be appreciably corrosive to aluminum. This is quite important from a practical point of view because it indicates the possibility of using aluminum for the construction of process equipment in glycol-amine-water plants containing 40 percent glycol or more without incurring risks of corrosion by acid gas free solutions. However, it has also been found that carbon dioxide reduces the corrosion of aluminum by an aqueous monoethanolamine solution containing 15 percent monoethanolamine-85 percent water and 0.08 mol of carbon dioxide per mol of amine. This solution showed very little corrosive action towards the aluminum specimens.

In order to determine the influence of oxygen or oxidation products of the monoethanolamine on the corrosion of steel, duplicate specimens were immersed in water and in an aqueous solution containing 15 percent monoethanolamine. These solutions were refluxed at their boiling points and a stream of air was passed through them for a period of 70 hours. The two specimens in the water showed bad corrosion and an average weight loss of 0.27 percent while only an average weight loss of 0.027 percent was found for the specimens contacted with the aqueous amine solution. This experiment indicates that monoethanolamine acted as a corrosion depressant for

TABLE 1

Corrosion of Carbon Steel and Aluminum 25 and 35 in Monoethanolamine (MEA)—Water and Monoethanolamine—Diethylene Glycol (DEG)—Water Without Acid Gas

SOLUTION	MATERIAL		Weight Grams	HOURS CONTACT Boiling	HOURS CONTACT Room Temp.	Weight Loss Grams
MEA-H_2O	Carbon Steel		5.6878	210	793	0.0004
MEA-H_2O	Carbon Steel		5.3556	210	793	0.0003
MEA-DEG-H_2O	Carbon Steel		6.0706	210	793	+0.0005
MEA-DEG-H_2O	Carbon Steel		5.0049	210	793	+0.0002
MEA-H_2O	Aluminum 28		2.3944	26		0.1579
MEA-H_2O	Aluminum 28		1.9497	26		0.1035
MEA-H_2O	Aluminum 28		2.5493		504	0.3737
MEA-H_2O	Aluminum 28		1.8723		504	0.2810
MEA-DEG-H_2O	Aluminum 28		1.9155	45		0.0002
MEA-DEG-H_2O	Aluminum 28		1.8325	45		0.0006
MEA-DEG-H_2O	Aluminum 28		1.8067		864	0.0015
MEA-DEG-H_2O	Aluminum 28		1.6805		864	0.0005
MEA-H_2O	Galvanic Couple	Carbon Steel	22.4463	70	286	+0.0014
		Aluminum 28	4.4470	70	286	0.0292
MEA-DEG-H_2O	Galvanic Couple	Carbon Steel	22.4900	70	286	0.0000
		Aluminum 28	4.4445	70	286	0.0000

straight oxygen corrosion, at least under the experimental conditions.

Series No. 2—Corrosion of Carbon Steel and Alloys in Amine Solutions in the Presence of Carbon Dioxide and Hydrogen Sulfide.

In this series of experiments, which involved hydrogen sulfide, a slightly different procedure and equipment were adopted. The equipment used to contact the specimens with the solution and the gas consisted of the same flasks and reflux condensers as those used in Series No. 1, but a closed system for continuous circulation of the acid gas was devised in order to prevent the contamination of the laboratory atmosphere with hydrogen sulfide.

This circulating system, together with the flasks where the solutions and the specimens were contacted, is shown schematically in Figure 7. It consisted of two stainless steel tanks, a blower, a two-liter bottle filled with soda lime for the disposal of excess acid gas, and accessory apparatus such as manometers, a pressure reducing regulator and a mercury seal. The acid gas was circulated by the blower through one of the tanks, which served as a surge vessel, into the flasks, the effluent gas from the latter being fed into the suction side of the blower. A maximum pressure of 40 mm of mercury was maintained on the system by means of the mercury seal and the pressure reducing regulator which was connected to the other tank serving as a reservoir for makeup gas.

Two specimens, after proper cleaning, drying, weighing and measuring, were placed in each flask together with the solution, and the gas flow was started in order to saturate the solutions. After 15 minutes, the solutions were heated to their boiling points and refluxed for a period of seven hours in a stream of acid gas. Heating was subsequently discontinued but the acid gas stream was maintained for one more hour, after which it was shut off and the solutions were left standing over night.

Five such cycles were repeated in seven days, after which time the specimens were removed from the solutions, cleaned, dried, weighed, measured and inspected. This procedure was repeated four times and a total of approximately 700 hours contact time was obtained consisting of about 550 hours contact with the cold acid gas saturated solution and 150 hours with the hot saturated solution. In this manner the rate of corrosion of these different materials under the test conditions was determined. Here again it should be emphasized that the results obtained do not represent absolute rates of corrosion, but rather a comparison of the corrosion of the materials tested under the experimental conditions. It is equally true for these experiments, as for the experiments involving only carbon dioxide, that the rate of corrosion of the tested alloys is quite different in boiling solutions with hydrogen sulfide and carbon dioxide and cold acid gas saturated solutions, and therefore no absolute values could be obtained.

The results of this series of experiments are presented in Figure 8. It is realized that only a few points, which are quite scattered, were used to establish the curve in Figure 8, and that therefore the value of this curve is only of a qualitative nature. However, it was felt that a definite trend in the corrosion of the materials tested was indicated and that it was justified to present this information in this form.

Inspection of the curve shows that of the materials tested, appreciable corrosion was shown only by carbon steel and 9 percent nickel steel, and in particular the latter, which seemed to corrode worse if hydrogen sulfide and carbon dioxide were present instead of carbon dioxide alone. The two chromium-molybdenum alloys, the two aluminum and the Type-304 stainless steel alloys did not show any appreciable corrosion and no change, except some darkening of the surface, could be noticed. The carbon steel and nickel alloy corroded quite evenly over the entire surface and pits of varying depth were well distributed. This series of experiments was conducted with a solution containing 15 percent of monoethanolamine, 80 percent of diethylene glycol and 5 percent of water. The acid gas consisted of a mixture of carbon dioxide and hydrogen sulfide in a 5:1 mol ratio. No analyses of the solution and the acid gas in this series, as well as in Series No. 1, were thought to be necessary since proper care was taken in the preparation of these mixtures.

Since no information was available on the electrolytic action between

Figure 9. Equipment for Dynamic Test

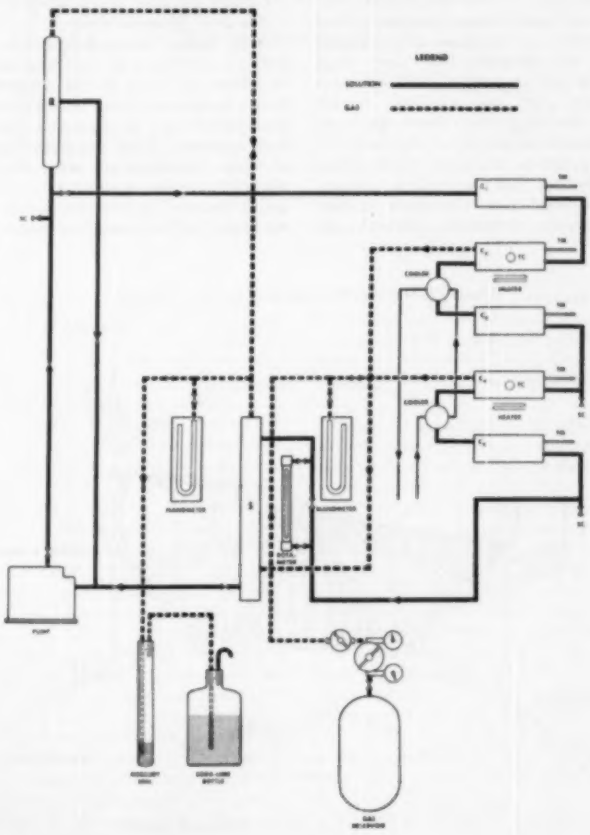


TABLE 2

Electrolytic Corrosion of Carbon Steel—Aluminum 35 Couples in Monoethanolamine (MEA)—Water and Monoethanolamine—Diethylene Glycol (DEG)—Water in the Presence of H_2O and CO_2

SOLUTION	WEIGHT—GRAMS		Hours Contact	LOSS—GRAMS		Hours Contact	LOSS—GRAMS		Hours Contact	LOSS—GRAMS		Hours Contact	LOSS—GRAMS	
	Steel	Aluminum		Steel	Aluminum		Steel	Aluminum		Steel	Aluminum		Steel	Aluminum
MEA-H_2O	22.4180	4.4548	192[1]	0.0002	0.0008	360[2]	0.0022	0.0000	528[3]	0.0049	0.0008	664[4]	0.0071	0.0020
MEA-DEG-H_2O	22.4490	4.4560	192[1]	0.1018	0.0001	360[2]	0.1356	0.0001	528[3]	0.1439	0.0000	664[4]	0.1620	0.0000
MEA-DEG-H_2O	22.4456	4.4562	192[1]	0.0873	0.0004	360[2]	0.1031	0.0008	528[3]	0.1321	0.0003	664[4]	0.2906	0.0008

[1] 180 hours cold acid gas saturated—42 hours hot acid gas saturated.
[2] 282 hours cold acid gas saturated—77 hours hot acid gas saturated.
[3] 416 hours cold acid gas saturated—112 hours hot acid gas saturated.
[4] 662 hours cold acid gas saturated—182 hours hot acid gas saturated.

aluminum and steel and also between iron sulfide and aluminum, a number of experiments was conducted in order to study this effect. Electrolytic couples of aluminum and steel were prepared in a modified form according to ASTM specifications (Figure 1) and subjected to the test procedure outlined above under Series No. 2, using solutions consisting of 15 percent monoethanolamine-85 percent water and 15 percent monoethanolamine-80 percent diethylene glycol-5 percent water, respectively.

The results of this phase of the investigation, shown in Table 2, indicate that in glycol-amine-water solutions in the presence of carbon dioxide and hydrogen sulfide, steel corrodes noticeably while no corrosion of aluminum could be detected. The steel discs showed pitting rather profusely distributed over the exposed surface while the aluminum discs displayed only slight darkening of the metal. In aqueous amine solutions, with carbon dioxide and hydrogen sulfide present, neither steel nor aluminum showed appreciable corrosion although the aluminum corroded slightly more than in glycol-amine-water.

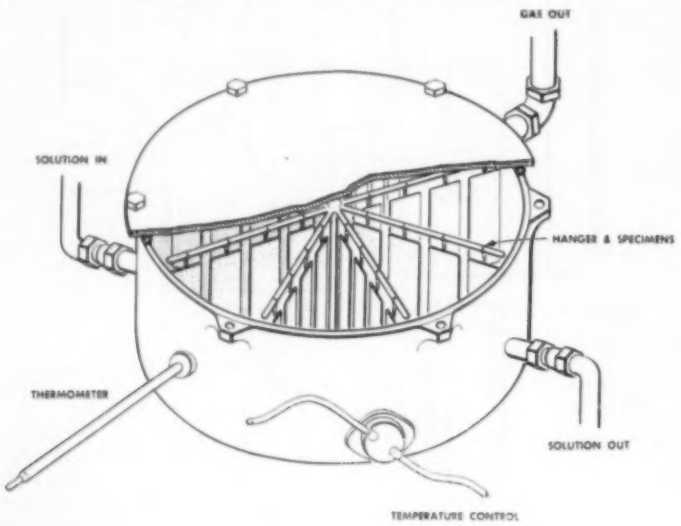
In connection with the investigation of electrolytic corrosion of aluminum-steel couples, some information was obtained on corrosion of such couples in aqueous and glycol-amine-water solutions free from acid gas (Table 1). It was found that in aqueous solutions, considerable corrosion of the aluminum occurred with no corrosion of the steel, while in the glycol-amine-water solution, no corrosion of either material could be detected.

Series No. 3—Corrosion of Carbon Steel and Alloys in a Glycol-amine-water Solution in the Presence of Carbon Dioxide and Hydrogen Sulfide in a Dynamic System.

After having obtained qualitative results on corrosion of steel and alloys in amine solutions, it was decided to devise equipment which would provide quantitative data on corrosion rates of such materials. Since the main interest of this investigation was directed toward corrosion occurring in glycol-amine systems, it was decided to use at first a glycol-amine solution for these experiments. A dynamic, continuously circulating system, involving saturation and stripping of the solution, was devised which is shown diagrammatically in Figure 9. It consisted of a saturator, S, which was a piece of 4-inch steel pipe approximately 3 feet long and filled with $\frac{3}{8}$-inch Raschig rings. This vessel was used for saturating the solution with acid gas. The solution entered the top of the saturator and after having passed through, it was withdrawn at the bottom and pumped by a small gear pump, *P*, partly into the reservoir, *R*, and partly into the contact chambers C_1 to C_3. Reservoir, *R*, consisted of a piece of 2-inch steel pipe approximately $1\frac{1}{2}$ feet long, on the side of which a line was attached which returned excess solution to the suction side of the pump, an arrangement necessitated by the fact that the pump circulated a considerably larger volume of solution than was intended to pass through the system.

The top of the reservoir was connected to the top of the saturator in order to equalize the pressure between these two vessels. The contact chambers, C_1 to C_3, which are shown schematically in Figure 10, were round steel vessels 10 inches in diameter and approximately 5 inches high with removable lids arranged in such a manner that C_2 was mounted below C_1, etc., C_3 being at the bottom. In this way, gravity flow of the solution through the system was obtained. The acid gas saturated solution entered C_1 at a temperature of 90° F., thence to C_2, where it was heated by an electric heater to 240° F. at which temperature it was partly stripped of carbon dioxide and hydrogen sulfide. After passing through carbon dioxide, the solution was cooled to 90° F. by a small cooler and passed through C_3 at this temperature. In C_3, the solution was heated further to 320° F. and stripped of its remaining acid gas. The now acid gas free solution was then cooled again to 90° F. and fed to C_1 at this temperature. After passing through C_3 and a small rotameter, it was returned to the top of the saturator, thus completing the cycle. The

Figure 10. Test Chamber (Approx. $4\frac{1}{2}$" x 11" Diameter)



acid gas removed from the solution in C_2 and C_4 was withdrawn at the top of these vessels and returned to the bottom of the saturator. Each contact chamber was provided with a thermometer well and both C_2 and C_4 were fitted with temperature regulators.

The pressure on the system was maintained by means of a pressure reducing regulator connected to a stainless steel gas tank containing carbon dioxide and hydrogen sulfide in a mol ratio of 5:1 and a mercury seal connected to a bottle filled with soda lime for the disposal of excess acid gas. In this manner, a constant pressure and supply of acid gas to the system was maintained. The specimens were placed in the contact chambers by suspending them on the beams of small stands shown schematically in Figure 10 in such a manner that they were totally immersed in the solution and, in order to prevent galvanic action, insulated from each other.

The following materials were used in this series:

1) Carbon steel condenser tubes.
2) 5 percent nickel steel coupons (Nicloy 5, Babcock and Wilcox).
3) 9 percent nickel steel coupons (Nicloy 9, Babcock and Wilcox).
4) 2¼ Cr.-1 Mo. steel coupons (2¼ percent chromium, 1 percent molybdenum, Timken).
5) 4-6 Cr.-½ Mo. steel coupons (4-6 percent chromium, ½ percent molybdenum, Timken).
6) Stainless steel coupons (18-8, Type 304, Timken).
7) Aluminum 2S tubes (Alcoa).

Small specimens of approximately 2 square inches surface were prepared from these materials. After proper cleaning, accurate weighing and measuring, four specimens of each of the materials to be tested were placed in each of the five contact chambers. The system was then filled with a solution containing 15 percent by weight of monoethanolamine, 80 percent by weight of diethylene glycol and 5 percent by weight of water. The liquid circulation was started and adjusted to approximately 0.02 gpm., and the temperatures in C_2 and C_4 were brought to 240° F. and 320° F., respectively, and regulated at this point. After attaining equilibrium, as indicated by constant temperatures and liquid level in the saturator, acid gas was added slowly to the system until the pressure on the top of the saturator reached approximately 100 mm of mercury. The pressure reducing regulator of the gas tank was now set to maintain constant pressure and the system was kept in operation continuously for a period of 456 hours.

After that time, one specimen of each material was removed from each contact chamber, cleaned, dried, and the weight loss during the contact period determined. The procedure was then continued and one specimen of each material was removed from each chamber after subsequent time increments of 695, 1152 and 696 hours. In this manner, the corrosion rate at different conditions was determined over a total period of 3000 hours contact, consisting of four increments. Each week, solution samples were withdrawn and analyzed for monoethanolamine, total acid gas and hydrogen sulfide content.

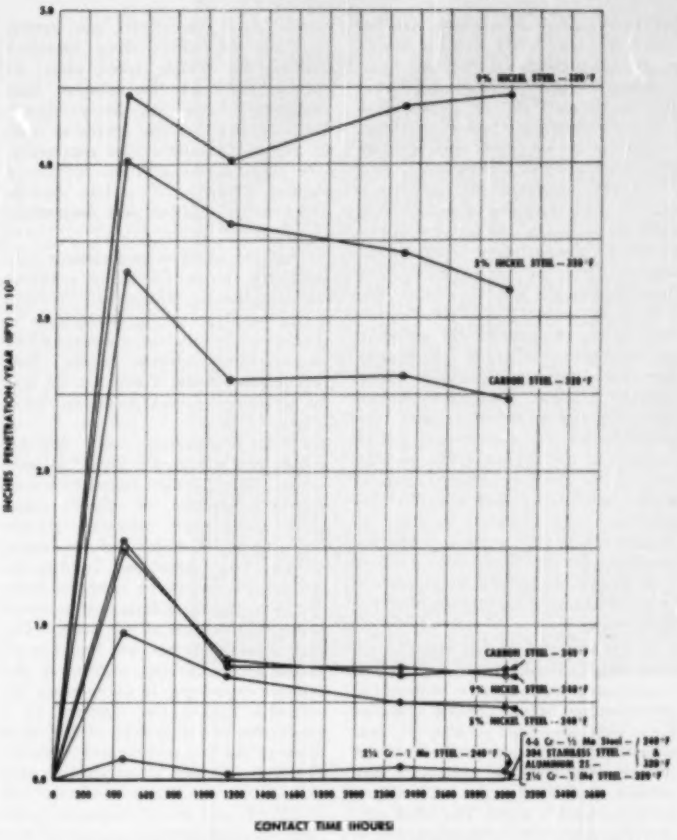

INCHES PENETRATION/YEAR (IPY) x 10³
CONTACT TIME (HOURS)
9% NICKEL STEEL – 320°F
5% NICKEL STEEL – 320°F
CARBON STEEL – 320°F
CARBON STEEL – 240°F
9% NICKEL STEEL – 240°F
5% NICKEL STEEL – 240°F
2¼ Cr – 1 Mo STEEL – 240°F
4-6 Cr – ½ Mo Steel – 240°F
304 STAINLESS STEEL – & ALUMINUM 2S – 320°F
2¼ Cr – 1 Mo STEEL – 320°F

Figure 11. Rate of Corrosion of Steel and Alloys in Monoethanolamine-Diethylene Glycol-Water at 240° F. and 320° F. Inches Penetration per Year (IPY) vs. Time.

The results of this series of experiments are presented in Figure 11. These data show that none of the materials tested showed measurable corrosion at 90° F., regardless of the degree of acid gas saturation. At 240° F., carbon steel, 5 percent nickel steel and 9 percent nickel steel showed appreciable corrosion in the solution which entered the contact chamber saturated with acid gas and was partly stripped in the chamber. The 2¼ Cr.-1 Mo. steel showed approximately 10 percent of the corrosion observed on carbon steel and no corrosion was found on the 4-6 Cr.-½ Mo. steel, Type 304 stainless steel and aluminum 2S.

Figure 11 demonstrates that the rate of corrosion of the four materials was quite constant except for the first time increment where it was slightly higher than during the remaining time. This is probably due to the dissolution of the original oxide layer which apparently takes place quite rapidly. General chemical corrosion with pitting distributed over the entire surface was observed on the carbon steel and the two nickel steel specimens. The 2¼ Cr.-1 Mo. steel showed little general attack. However, a few isolated pits were found on the otherwise intact surface. No change could be observed in the appearance of the 5 Cr.-1 Mo. steel, Type 304 stainless steel and aluminum 2S specimens.

At 320° F. and in a solution enter-

ing the contact chamber partly stripped and being completely stripped during its passage through the chamber, 9 percent nickel steel, 5 percent nickel steel and carbon steel showed quite considerable corrosion. The rate of corrosion of the two nickel steels was approximately six times that observed at 240° F. in the saturated solution, while carbon steel corroded approximately three times as fast. As can be seen in Figure 12, the corrosion rates of these materials were uniform after the first time increment. The 2¼ Cr.-1 Mo., 5 Cr.-1 Mo. steel, Type 304 stainless steel and aluminum 2S did not show any corrosion at this high temperature. The two nickel steels and the carbon steel specimens displayed general chemical corrosion with pits distributed over the entire surface. The surfaces of the 2¼ Cr.-1 Mo. and the 5 Cr.-1 Mo. steel specimens had darkened considerably and indicated the formation of a protective coating. No change could be observed in the appearance of the Type 304 stainless steel specimens and the aluminum 2S samples showed slight darkening of the surface.

It was intended in this series of experiments to duplicate to some degree conditions prevailing in a commercial glycol-amine plant. Contact chamber C_2, which was kept at 240° F., was supposed to simulate the hottest part of the solution heat exchanger and contact chamber C_4, the still and reboiler of such a plant. The other contact chambers were representative of other parts of the system such as the absorber, piping, pumps, etc. It is realized that it is not possible to duplicate field conditions in as small apparatus as the one used, and in particular, it was not possible to separate the still from the reboiler, in both of which the conditions are quite different. Furthermore, the corrosion of carbon steel seems to be affected considerably by evolution of gas bubbles on the metal surface due to flashing of acid gas, and the experimental arrangement did not permit studying this effect since localized over-heating which takes place in certain parts of the solution heat exchanger could not be produced. However, it is felt that corrosion rates of various materials in a representative glycol-amine solution containing varying amounts of carbon dioxide and hydrogen sulfide were determined significantly.

This last series of experiments substantiated the results of the previous series, indicating that carbon steel and nickel steel are quite susceptible to corrosion in amine systems while chromium-molybdenum steels, 18-8 stainless steel and aluminum 2S and 3S are quite resistant to the corrosive attack.

Before concluding, some data on actual field experience should be presented. The corrosion found in a considerable number of plants using glycol-amine-water solutions, removing carbon dioxide and hydrogen sulfide from natural gas, follows the general pattern to be expected from the theoretical considerations discussed in the introduction of this article. The most severe corrosion was found in all plants in the hottest section of the solution exchanger. In many cases, the corrosive failure was confined to a small area in the vicinity of the entry point of the hot regenerated solution. The lean solution temperature at this point varies from approximately 300 to 325° F. and severe corrosion in the form of deep pitting and actual severance of exchanger tubes very close to the tube sheet was found. The average life of an exchanger bundle varied from seven to ten months in plants which were operated properly and where the reboiler temperature was approximately 300° F. In two instances, reboiler failures due to corrosion were found. However, both of these plants were operated improperly and acid gas stripping was allowed to take place in the reboiler.

Several instances of reboiler and still corrosion have been observed in treating plants using aqueous-amine solutions. It appears from this experience that reboilers of plants using pressure regeneration and subsequently higher temperatures in the reboiler corrode faster than those in plants using low pressures on the regeneration stage. In one particular plant where carbon dioxide was removed from flue gas and the solution was regenerated at a pressure of 35 psig., several reboiler failures after 60 to 90 days were observed regularly. In another instance where even higher temperatures prevailed in the reboiler, the life of the reboiler was even shorter. On the other hand, not quite so severe corrosion was found in a plant removing carbon dioxide and hydrogen sulfide from natural gas and using an aqueous monoethanolamine solution where the still was operated at substantially atmospheric pressure. No accurate records are available from this source, but the reboiler did not fail for at least one year.

The information and conclusions presented demonstrate the complexity of the corrosion problem at hand. This article is intended to contribute to the clarification of the chemical aspects of the problem, without consideration of mechanical features involved in the design of the equipment.

ACKNOWLEDGMENT

The authors wish to express their appreciation to The Timken Roller Bearing Company, Steel and Tube Division, The Babcock & Wilcox Tube Company, Aluminum Company of America, El Paso Natural Gas Company, and the staff of the Research Department of The Fluor Corporation, Ltd., for their valuable assistance in providing materials and gathering information used in this article.

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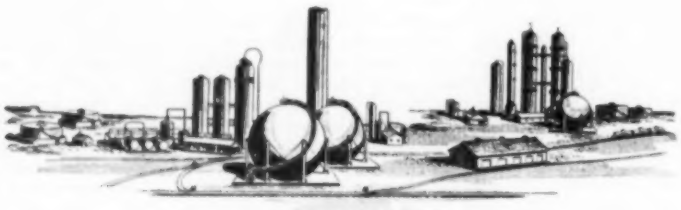
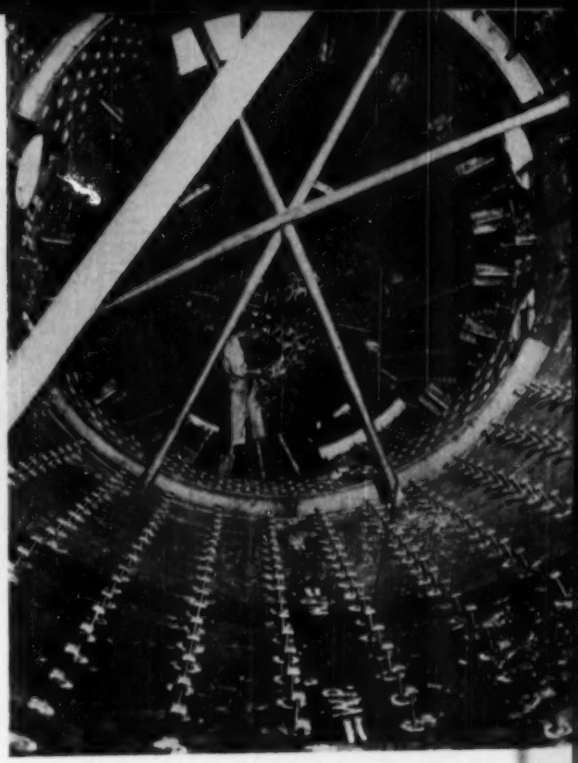


Stud Welding Simplifies Refractory Work



Refractory tile which lines this catalyst regenerator at Sun Oil Company's new Toledo, Ohio, refinery is supported by square-headed stainless steel studs positioned on the lining with an automatic stud-welding gun. The supports consist of ½-inch by 4-inch AISI type 316 stainless steel studs, flux-filled at both ends, which were stud welded to the 2-inch square plates forming the heads prior to shipment from the plant.

STUD welding, which has proven a valuable cost-reducing aid in many aspects of refinery construction and maintenance work, has been used in an entirely new and highly significant way to simplify the installation of refractory materials in the Sun Oil Company's new Toledo refinery.

Special ½-inch by 4-inch flux-filled AISI Type 316 stainless steel studs, with 2-inch squares of Type 316 stainless plates, are used to hold insulation blocks and refractory tiles in place within the regenerators. One end of the stud was first shop welded to the plate, and these weldments were then shipped to the Sun Shipbuilding and Dry Dock Company yards where the other end was stud welded to the inner shell of the catalyst regenerator with the assistance of a special chuck developed for this purpose. The studs were welded to center punch marks laid out during the fabrication of the tank. These weldments support special tongue-and-groove high temperature refractory tile, which was specially designed to fit over the square-headed studs.

A special sealing cement was first applied to the tank wall, after which 40-pound insulation blocks were placed on the studs next to the shell, to fill the space between it and the refractory tile. The tongue-and-groove tiles were then placed in position over the studs and supported by the 2-inch square of stainless steel.

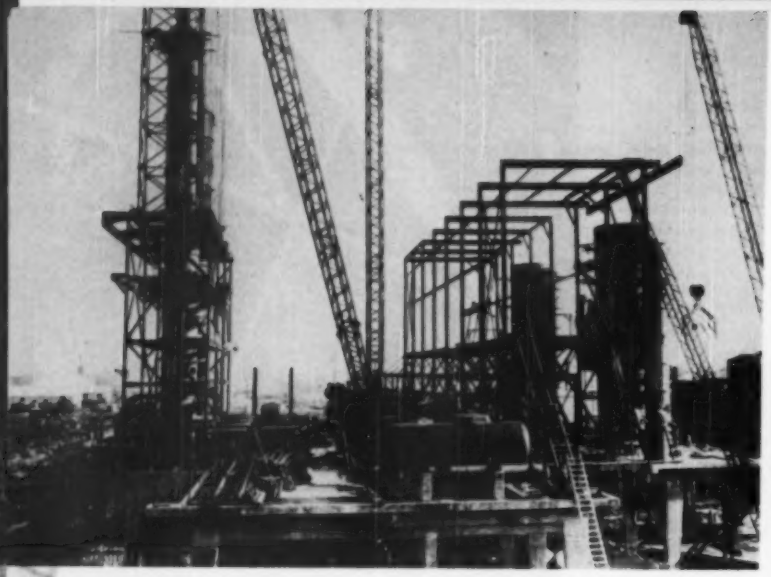
In addition to reducing installation costs, this new method of securing refractory tile to regenerators will lower maintenance costs and improve operation of the equipment.

Tile life should be improved, as there is no cumulative loading, and because a special abrasion-resisting ladle-mix refractory has been employed. Since only one type of tile was used for the entire regenerator, maintenance inventories will be lowered and replacement of broken tiles is comparatively simple. Nearly perfect insulation of the tank wall is achieved and the intimate fit of the insulation blocks behind the refractory tiles results in a complete gas seal to minimize the possibility of gas getting behind the insulation and causing hot spots on the tank wall.

Collaborative engineers on this new application were members of the La-Clede Christy Company staff; Catalytic Construction Company, Inc., designers and engineers of the Toledo project; and the staff of Nelson Stud Welding Division, Morton Gregory Corporation.

Square-headed stainless steel studs inside the shells of the regenerator protrude beyond the insulation block and serve as a seat for support of grooved tile which lines the inside of these units. Insulation blocks, already in place, were fitted in and around the studs.

View of an upturned section of the tongue-and-groove high-temperature refractory tile shows the slot which is provided in the bottom toward the outside of the tile to fit over the square-headed studs.



View of Shell Haven Refinery Distillation Plant 102 looking East with Column C.4 and C.5 Structures to Left. Column C.7, C.3, C.6 and C.1 can be seen on the right. The pumphouse in the center foreground has a 75-ton derrick mounted on the roof.

Work Progressing on Shell Haven Plant in England

DR. E. N. TIRATSOO, London

INITIAL operation of the new Shell Haven refinery being built on a 200-acre site near Southend, Essex, England, is scheduled for November, 1950 with additional facilities, including a reforming unit, ready by May, 1951, and the complete job finished by November, 1951.

The first distillation plant to be ready late this year will process a designed intake of 42,000 barrels per stream day of crude oil. A doctor treating plant will provide facilities for treating 9100 barrels straight-run gasoline daily. Also included in the primary refinery program are pump and weigh houses for t.e.l. blending.

A high degree of control by instrumentation is planned and there will be almost complete elimination of steam for operating pumping units most of which will be electrically driven.

The reforming unit will process some 9500 barrels daily of naphtha or light gasoil and will be followed by installation of a feed preparation plant designed to handle about 17,000 barrels per stream day of bitumen feedstock. This latter unit is due to be completed in November, 1951.

Heat exchange equipment will be serviced by water from the Thames pumped through a tunnel 900 feet long and nine feet in diameter. After circulation, the water returns through a large oil interceptor before discharge into the river. A water pump house 250 feet by 50 feet has the main pump units assembled 30 feet below ground level. Steam-turbine driven pumps are of 2600-gpm. capacity.

In the initial stages of operation, 250 psig. boilers will supply steam to the various refinery plants and to general site ancillary equipment, pumphouses, tank farms, shops, offices, etc. The layout allows for future installation of a duplicate set of boilers. Facilities for compressed air supply are provided.

Electrical power is obtained by two main feeders to the intake substation transforms, thus affording insurance against possible failure of either center.

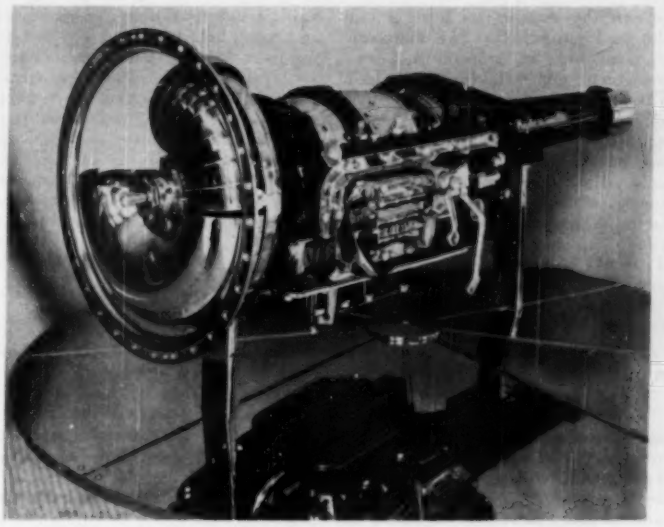
An efficient system of chemical treatment for the raw water is essential and an elaborate setup of treating equipment, settling tanks, pumps, lines, etc., is being installed.

An aggregate of 3,500,000 barrels tank capacity is being provided. New 98,000-barrel capacity crude oil storage tanks are scheduled.

On a 20-acre site near the refinery 140 houses will be built for the permanent operating personnel of the refinery. Five miles of concrete roads and 4½ miles of railway sidings have been laid.

Under the direction of Sidney Wraight, general manager at Shell Haven, more than 2200 men are engaged on the construction of this new refinery which with its twin plant at Stanlow, on the Manchester ship canal, will handle more than 115,000 barrels of crude oil daily and will produce a complete range of refined petroleum products.

Miners are working 50 feet under the Thames at Shell Haven, Essex, to build a tunnel 900 feet long to the site of the refinery. Photo shows miners coming out of the entrance air lock after finishing an eight-hour shift in the pressurized underwater tunnel.



Cut-Away Model Showing Hydra-Matic Drive as Used on Cadillac and Lincoln.

Automatic Transmission Fluid—Type A, for Passenger Cars

H. R. WOLF, General Motors Corporation, Detroit, and
J. L. McCLOUD, Ford Motor Company, Dearborn

THE demand for automatic transmissions in passenger cars has increased rapidly during the past several years, until at the present time approximately 1½ million units are in service. This trend will continue, and no doubt, during the next few years, a larger number of car manufacturers will employ some type of automatic transmission.

When the fully-automatic transmission was first introduced as optional equipment on passenger cars, the special fluid required for satisfactory operation in service was not available through the petroleum industry retail marketing channels. As a temporary expedient the car manufacturer supplied production fluid as a service replacement part through its authorized car dealers. The tremendous increase in the number of automatic transmissions in service now makes it desirable for the retail gasoline filling stations to be in a position to service these units at the same time other lubrication work is performed.

Obviously, the petroleum industry cannot be expected to supply, through their gasoline filling stations and other retail marketing outlets, different types and viscosity grades of fluids for use in each of the different models and types of automatic transmissions. This would result in no end of confusion and in general misapplication of these special fluids.

Standardization of fluids for passenger car automatic transmissions, including torque converters, was required before these products could be merchandized through the regular petroleum industry channels. In addition to standardizing on a single fluid for passenger car use, some mechanism must be provided for qualifying and for identifying fluids which meet the requirements of the equipment manufacturers.

NOW THAT automatic transmissions are coming into general use on passenger cars and service stations have taken on the responsibility of supplying the special fluids required for these mechanisms, many refiners are entering the field of manufacturing suitable transmission fluids. This article outlines the general properties of one such fluid which is considered suitable for the majority of automatic transmissions now in use. A procedure is given for qualifying transmission fluids to meet the requirements of equipment manufacturers.

This discussion was originally presented at the Society of Automotive Engineers national fuels and lubricants meeting held last November in St. Louis.

One approach to the problem of qualifying automatic transmission fluids by petroleum refiners and marketers for direct sale to car owners was presented in a bulletin[1] issued by General Motors Corporation under date of May 18, 1949. This bulletin outlines the detailed requirements for a single fluid which will provide satisfactory operation in all past and current model General Motors passenger car automatic transmissions. Included is a procedure by which interested petroleum refiners and marketers can qualify their products for use in General Motors cars. Each company, of course, will market its fluid under its own brand or trade name.

The program[1] proposed by General Motors Corporation was formulated to cover not only the corporation's requirements for a single fluid for use in both the "hydra-matic" and torque converter types of current production automatic transmissions, but also to enable other equipment manufacturers to take advantage of the standardization and qualification procedures without referring to the fluid as a General Motors product. This is a distinct advantage, not only to the automotive industry, but more importantly, to the petroleum industry, as it permits the use of a single fluid in service, thereby greatly simplifying the problem of recommending fluids and avoiding the confusion which would result in servicing units in the field with the wrong fluid.

To successfully establish a long range program which will permit the fluid-servicing of automatic transmissions, by gasoline filling stations and independent garages, it is imperative that the minimum number of fluid types be supplied. Similarly, the necessity for standardization of each fluid type is obvious.

The use of engine oils and inferior substitute fluids can result in serious and costly service failures. Inferior fluids do not cause immediate failure and, consequently, give the owner a false sense of security. To em-

phasize the necessity for using a fluid designed especially for automatic transmissions, an uniform and well recognized nomenclature is required. The designation "Automatic Transmission Fluid, Type A," prefixed by the marketers own brand or trade name, has been adopted to identify the type of fluid required for current production passenger car automatic transmissions. Widespread use of the generic name, "Automatic Transmission Fluid, Type A," by both the automotive and petroleum industries, will assist materially in constantly calling attention to the necessity for correct fluid-servicing of automatic transmissions in passenger cars.

Type A

Different designs of automatic transmissions may require fluids of somewhat different functional characteristics. Generally these differences reflect in the degree of oxidation resistance and the range in viscosity required for the most efficient operation.

At the present time three viscosity ranges are required to service the commercial automatic transmissions now in production and in use in the field. An extremely light fluid having a viscosity of approximately 35 seconds Saybolt Universal at 100° F. is specified for one design of torque converter which is used largely in the industrial field. A slightly heavier fluid having a viscosity of approximately 65 seconds Saybolt Universal at 100° F. is specified for use in a different design of torque converter used primarily in the bus and coach field. A third fluid, having a viscosity of 54 to 56 seconds Saybolt Universal at 210° F., is required for the current production models of passenger car automatic transmissions.

While much has been accomplished in the standardization of a single fluid for use in current types of automatic transmissions, no assurance can be given that this particular fluid will remain the best compromise for future designs of passenger-car transmissions. A lower or even a higher viscosity fluid may be required in new designs at some future time. Regardless of future requirements, the present fluid will be needed for service, for a number of years, in the present production models.

To establish a nomenclature that will provide for future developments and to avoid confusion which may result from the introduction of additional types of passenger car fluids, the present fluid has been designated as "Type A." If and when additional viscosity ranges are required, they may be designated as "Type B," "Type C," etc., or by other appropriate designations.

To date, the recommendations for fluids in industrial units and in the bus and coach field have been handled by the individual equipment manufacturers largely in terms of brand or tradenames based on experience in service. As the use of these units is extended to other fields, and particularly when it becomes desirable to expand the fluid-servicing of these units, the required fluids may be identified as "Automatic Transmission Fluids," with an appropriate type designation to indicate the specific use for which each grade is intended.

General Requirements

An automatic transmission fluid must perform a number of different functions; the exact combination of properties required in a specific fluid depends entirely on the design of the unit in which it is used and on the operating conditions.

In automatic transmissions employing a fluid drive or a torque converter the fluid serves as a power-transmission medium, a heat-transfer medium, and a lubricant for bearing surfaces. Many automatic transmissions also utilize the fluid as a hydraulic control fluid and a gear lubricant.

To satisfactorily perform all of these functions under all service operating conditions in different types and models of passenger-car automatic transmissions, fluids compounded by different refiners for direct sale to car owners and car dealers do not necessarily have to be compounded on the same formulation, but they must provide:

a) complete miscibility with the fluids used by the equipment manufacturers for the initial factory fill and with all other fluids available for use in service
b) maximum resistance to oxidation
c) operation over a maximum temperature range
d) minimum volatility
e) minimum anti-foam characteristics
f) maximum protection against corrosion and rusting of component parts
g) minimum effect on seals
h) freedom from squawking or chatter in units where a change in ratio is accomplished by shifting under engine power
i) freedom from toxic properties

Each of the above requirements may not be necessary for satisfactory operation in each individual transmission design; however, the concept of a single fluid for use in all current passenger car automatic transmissions requires somewhat broader fluid characteristics than would be required if individual fluids were designed for each individual unit.

The advantages to the equipment manufacturers and the petroleum marketers gained through the use of a single fluid far outweigh any slight economy in original fluid cost and avoid the confusion that would result from the use of a large variety of service fluids each designed for an individual transmission unit.

Detailed Requirements

To enable petroleum refiners and marketers to supply, through their retail filling stations, fluids equal in performance characteristics to the service replacement fluids marketed by their parts and accessories departments to their authorized car dealers, General Motors has established the following minimum requirements for "Automatic Transmission Fluid, Type A," for use in Hydra-Matic and Dynaflow transmissions:

a)	Miscibility,	Pass
b)	Viscosity, Saybolt Universal 210°F.,	54 seconds, minimum 56 seconds, maximum
c)	Viscosity Index,	150 minimum
d)	Flash Point, °F.,	365 minimum
e)	Fire Point, °F.,	395 minimum
f)	Pour Point, °F.,	—35 maximum
g)	Copper-Strip Test,	Pass
h)	Anti-foaming Properties,	Pass
i)	Heating Test,	Pass
j)	Non-Corrosion and Non-Rusting Properties,	Pass
k)	Effect on Seals,	Pass
l)	Odor,	Pass
m)	Non-Toxic Properties,	Pass
n)	Oxidation Test on Fluid as Marketed,	Pass
o)	Oxidation Test on Fluid diluted with equal volume of Reference Oil,	Pass
p)	Non-Chatter or Squawking Properties,	Pass
q)	Durability (Cycling Test),	Pass
r)	Viscosity Stability,	Pass
s)	Frictional Properties,	Pass
t)	Performance in Transmissions under Service Conditions,	Pass

The above minimum requirements, except for a slight change in viscosity and viscosity index, are identical with the present requirements for current production and service fluids used in Hydra-Matic and Dynaflow transmissions.

A number of refiners are now developing fluids to meet these requirements. They should be in commercial production early in 1950.

Automatic Transmission Fluid, Type A, will be available to all equipment manufacturers for initial factory fill and for service. In some specific de-

signs all of the properties incorporated in the Type A fluid may not be required; manufacturers of these units may elect to use fluids of their own formulation for the initial factory fill and take advantage of the Type A fluid only for service.

Effect of Physical Properties On Performance

Most of the requirements are obvious; however, a brief discussion of the individual properties may be of interest, particularly in the development of new fluids.

Miscibility: Regardless of the merits of an individual fluid it must be miscible with all fluids used in production by the several equipment manufacturers; and each new fluid designed for use in service must be miscible not only with the production fluids, but also with all previous and current service fluids.

Viscosity: The viscosity requirement is fixed not only by the design of the hydraulic power transmission section of the unit, but is influenced by the other multiple functions which the fluid must perform. These include general lubrication, gear lubrication, clutch and service lubrication and the operation of hydraulic controls.

The viscosity range at 210° F. in the modified Type A Fluid has been increased slightly to permit higher pressures at higher operating temperatures in the hydraulic control systems to insure more satisfactory performance under extreme service operating conditions.

Viscosity Index: A high viscosity index is required to provide the maximum range in operating temperature and to eliminate seasonal fluid changes.

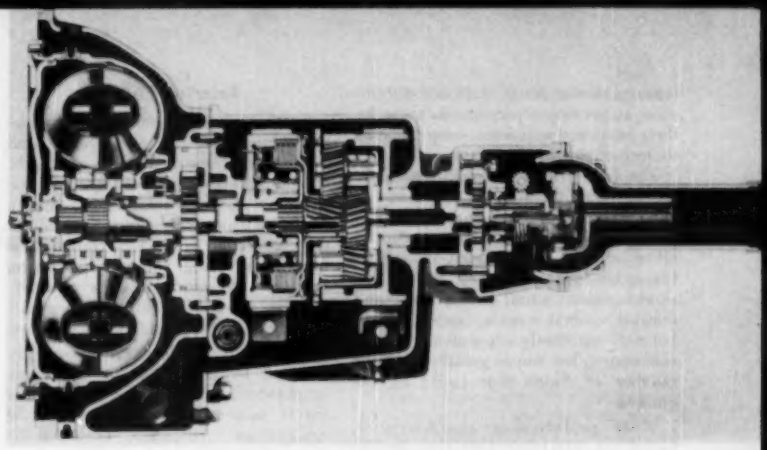
The increase to a minimum viscosity index of 150 in the modified Type A Fluid was made to provide improved operation over a wider temperature range and to insure that a single fluid can be used in all current production passenger car automatic transmissions.

Flash and Fire Points: Maximum flash and fire points, consistent with other physical properties, are required to minimize fire hazards in operation and to reduce the tendency toward cavitation caused by vaporization in the hydraulic power transmission section.

Pour Point: A low pour point is required to insure pumpability of the fluid at low temperatures.

Copper-Strip Test: The conventional copper-strip corrosion test is included as a preliminary test to detect fluids containing addition agents that may have a detrimental effect on copper alloys.

Anti-Foaming Properties: The fluids are circulated rapidly in operation and air may be entrapped. Excessive foaming may cause overflow and loss of fluid. Entrapped air also interferes in the operation of the power transmission unit and hydraulic control devices and may cause operational failures in service.



Section of Torque Converter as Used in Chevrolet "Powerglide" Transmission.

Heating Test: The heating test is a preliminary test to determine the ability of the fluid to withstand prolonged heating at high temperature without decomposition.

Rust Prevention Characteristics: Moisture may accumulate through condensation under some operating conditions; consequently, protection of the component parts against rusting or corrosion is essential.

Effect on Seals: The synthetic seals used in automatic transmissions were developed to have the maximum resistance to changes in dimensions and in hardness in contact with production fluid at high temperature. The effect of a fluid on the seal material is determined by the source and method of processing of the base stocks used in compounding the fluid and may be modified by the additive agents.

Odor and Non-Toxic Properties: The necessity for a fluid free from odor and toxic properties in a passenger car is obvious. The fluid must also be nontoxic to the personnel engaged in servicing units in production and in the field.

Oxidation Resistance: Automatic transmission fluids require a higher degree of oxidation resistance than engine oils. CLR L-4 oxidation tests are therefore required on the fluid as compounded and on the fluid after dilution with an equal volume of a mineral reference oil free from added oxidation inhibitors. This combination of L-4 oxidation tests is intended to insure the proper degree of oxidation resistance and to detect fluids which may precipitate soluble oxidation products when other types of fluids are used for make-up or for replacement in service.

Non-Chatter or Squawking Properties: Chatter and squawking, which is a "stick-slip" phenomena, requires special emphasis on the frictional characteristics of the fluid. These properties are evaluated in the durability or cycling test, the OM2 bearing test and in the actual road performance tests.

Durability Test: This is a laboratory simulated service cycling test on a full scale, engine driven, production unit in which the operation is conducted under full engine power through the entire speed range. This test was designed to reduce the amount of actual road durability testing that would otherwise be required to evaluate performance in service.

Viscosity Stability: This test also reflects the oxidation resistance of the fluid and is based on the change in viscosity of samples withdrawn at intervals during the durability test.

Frictional Properties: The frictional properties of a fluid determine the nonchatter or squawking characteristics and the smoothness of operation of clutches and servo-mechanisms. The OM2 bearing test is also used to indicate any reaction of additive agents present in the fluid with bearing or frictional surfaces that might form surface films which would have an adverse effect on their frictional characteristics.

Performance Tests: These tests, conducted on the road under severe operating conditions in several different types of automatic transmissions, serve as a final check on a fluid to assure satisfactory performance under all field conditions.

Qualification of Type A Fluids

A program for qualifying "Automatic Transmission Fluid, Type A," has been developed with Armour Research Foundation.[3] This program is being sponsored by General Motors Corporation in order to identify to car owners and car dealers fluids which are equivalent in performance charac-

teristics to the fluids that are distributed as service replacement parts by their parts and accessories departments to authorized car dealers.

The final criterion for an automatic transmission fluid is the same as for any other component part—it must provide satisfactory operation under all conditions encountered in service for extended periods of time. This would require actual performance and durability service tests. Such tests are not only extremely expensive and time consuming, but would greatly limit the number of fluids that could be examined.

Since performance characteristics, based on extended previous service experience, can be expressed quite accurately by physical properties and simulated performance tests, the preliminary laboratory testing procedure conducted by Armour Research Foundation serves as a rapid screening process to permit final appraisal by less complex performance and durability tests. The performance tests will be conducted by General Motors in current production units.

The qualification program provides for a review of the laboratory and performance test data by the General Motors committee on automatic transmission fluid. This committee is composed of members of the engineering staffs of the manufacturing divisions and a representative of Armour Research Foundation.

Qualification numbers are issued by Armour Research Foundation to identify the individual products which meet the minimum requirements for "Automatic Transmission Fluid, Type A."

Interim Fluids

Some time will be required by the petroleum industry to develop and qualify the modified Type A fluids. During this interim period, until distribution can be established, and a complete change-over can be made to the modified product, arrangements have been made whereby petroleum refiners and marketers may qualify current production fluids for resale under their own brand or trade-names.

These interim fluids are being distributed by a number of petroleum marketers and are being offered for direct sale to car owners under the designation "Automatic Transmission Fluid, Type A."

The modified fluid will continue to be designated as "Automatic Transmission Fluid, Type A;" consequently, the change-over can be accomplished in an orderly manner without any change in container design and brand or trade-name.

Equipment Manufacturers Recommendations

The individual equipment manufacturers must be responsible for the type of fluid used for initial factory fill and for recommendations to their service organization and to their individual car owners.

General Motors Car Divisions and the Lincoln Mercury Division of the Ford Motor Company are recommending to their car dealers and car owners the original equipment fluids, which are available to all authorized dealers through their respective division parts and accessories departments, or a properly qualified automatic transmission fluid, Type A, supplied by a reputable marketer and identified by an Armour qualification number, for use in all General Motors passenger car automatic transmissions and in Lincoln "hydra-matic" transmission.

Other car and equipment manufacturers, who require a service fluid of similar properties, may specify the use of "Automatic Transmission Fluid, Type A," in their units with the assurance that they are recommending a product of known performance characteristics which is accredited by a neutral laboratory and which can be readily identified by the car dealer and by the individual car owner.

Conclusions

Automatic Transmission Fluid, Type A, provides a single fluid of known performance characteristics for use in passenger car automatic transmissions.

The qualification procedure and the Armour qualification number provide a positive means for identifying fluids meeting the minimum requirements.

Cooperative work by the petroleum and automotive industries over a period of years has resulted in the development of improved products and in a reduction in the number of types and viscosity grades required for service applications.

New problems will result from the extended use of automatic transmissions. These problems, as they arise, will be solved through the continued cooperative efforts of the two industries.

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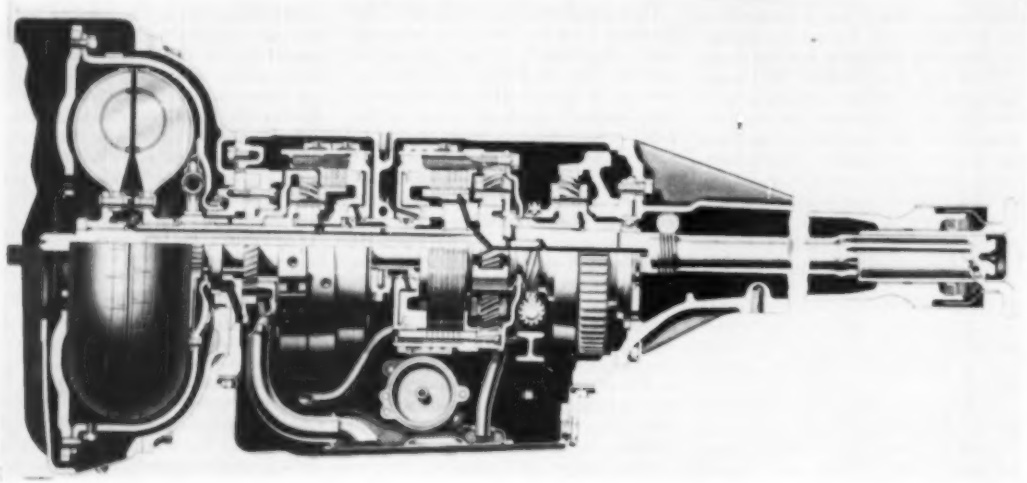
[1] General Motors Passenger Car Automatic Transmission Fluid, (Procedure for Qualifying Fluid for Direct Sale by Petroleum Refiners and/or Marketers to Car Owners). General Motors Corporation, May 18, 1949.

Section of Hydra-Matic Drive as Used on Cadillac and Lincoln.



PRESSURE DROP

In Gas and Vapor Lines

PRESSURE drop calculations and pipe sizing for vapor and gas lines are an important part of the process plant engineer's work. This article reviews the problems that the most frequently encountered and presents some typical examples of their solution.

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THE main problem in calculating pressure drop in liquid lines in most cases, is the pressure drop due to fluid friction. There is no significant change in density and the velocity head is usually small and can easily be taken into account.

Flow of gases or vapors in a line is complicated by the fact that when a large pressure drop is encountered, the density varies along the line and the outlet velocity is greater than the inlet velocity. If the pressure drop is made larger and larger, a point is finally reached where maximum flow is encountered and where the exit velocity is the critical velocity.

If the pressure drop is small, the density is substantially constant and the equations for liquid flow may be used with sufficient accuracy in gas line problems. With large pressure drops, however, a differential equation must be written which presents a more complicated form for solution.

The process engineer is often confronted by a problem of flow in short vapor lines where the pressure drop is large enough to require the use of equations developed from the more complicated form. It is the purpose of this article and the accompanying charts to present a graphical solution for problems in gas flow for all ranges of pressure drop up to the critical velocity.

The fundamental differential equation as presented by Dodge[1] for horizontal lines is as follows.

$$\frac{2fG^2\,dL}{gD} + \frac{G^2\,dV}{g\,V} + \frac{dP}{V} = 0 \qquad (1)$$

For an isothermal case and an ideal gas, this may be integrated and presented in either of the two following forms,

$$\frac{2fG^2L}{g\,D} + \frac{G^2}{g}\ln\frac{P_1}{P_2} + \frac{M}{2RT}(P_2^2 - P_1^2) = 0 \qquad (2)$$

$$\frac{G^2T}{MP_1^2} = \frac{\frac{g}{2R}\left[1-\left(\frac{P_2}{P_1}\right)^2\right]}{\left[\frac{2fL}{D} - \ln\frac{P_2}{P_1}\right]} \qquad (3)$$

For a constant friction factor, this presents a relationship between these three groups of variables,

$$\frac{G^2T}{MP_1^2}\ ;\ \frac{L}{D}\ ;\ \text{and}\ \frac{P_2}{P_1}.$$

NOTATION

- $A = \sqrt{M/TG^2}$, obtained from Figure 2.
- f = friction factor, .004 in reference equations.
- D = pipe diameter, feet in reference equations, inches on chart.
- g = acceleration of gravity, 32.2 ft./sec.^{2}
- G = mass velocity, lbs./hr.-sq. ft.
- L = length of line in feet.
- M = molecular weight of gas.
- P = pressure, pounds per square foot in reference equations. Use notation when using chart.
- R = gas constant, 1544 as used in reference equations.
- T = absolute temperature of gas, °R.
- V = specific volume of gas, cu. ft./lb.
- Z = gas compressibility factor.

Subscripts 1 and 2 refer to inlet and outlet conditions respectively.

Figure 2 is a chart for getting part of the first group and gives the term A which is $\sqrt{M/TG^2}$. Figure 1 combines the P_1 to complete the first of the above groups of variables. Also on Figure 1 are lines of L/D representing the second group of variables. The result of combining these two groups is given at the top of Figure 1 as a function of the third grouping. This function is plotted as $(1 - P_2/P_1)$ or $(P_1 - P_2)/P_1$, which is the pressure drop expressed as a fraction of the inlet pressure.

A friction factor of .004 was taken as an average value for high velocity gas flow and the chart uses that value. If a line is known to be operating with a fanning friction factor greatly different from .004 its value should be obtained and an $(L/D)'$ used when reading the chart.

Due to the variety of friction factors in common use, the following forms of equation are presented for $(L/D)'$.

Friction factor in Fannings equation,

$$\left(\frac{L}{D}\right)' = \frac{f}{.004}\,\frac{L}{D} \qquad (4a)$$

Friction factor as used by Pigott,[2] and Moody[3]

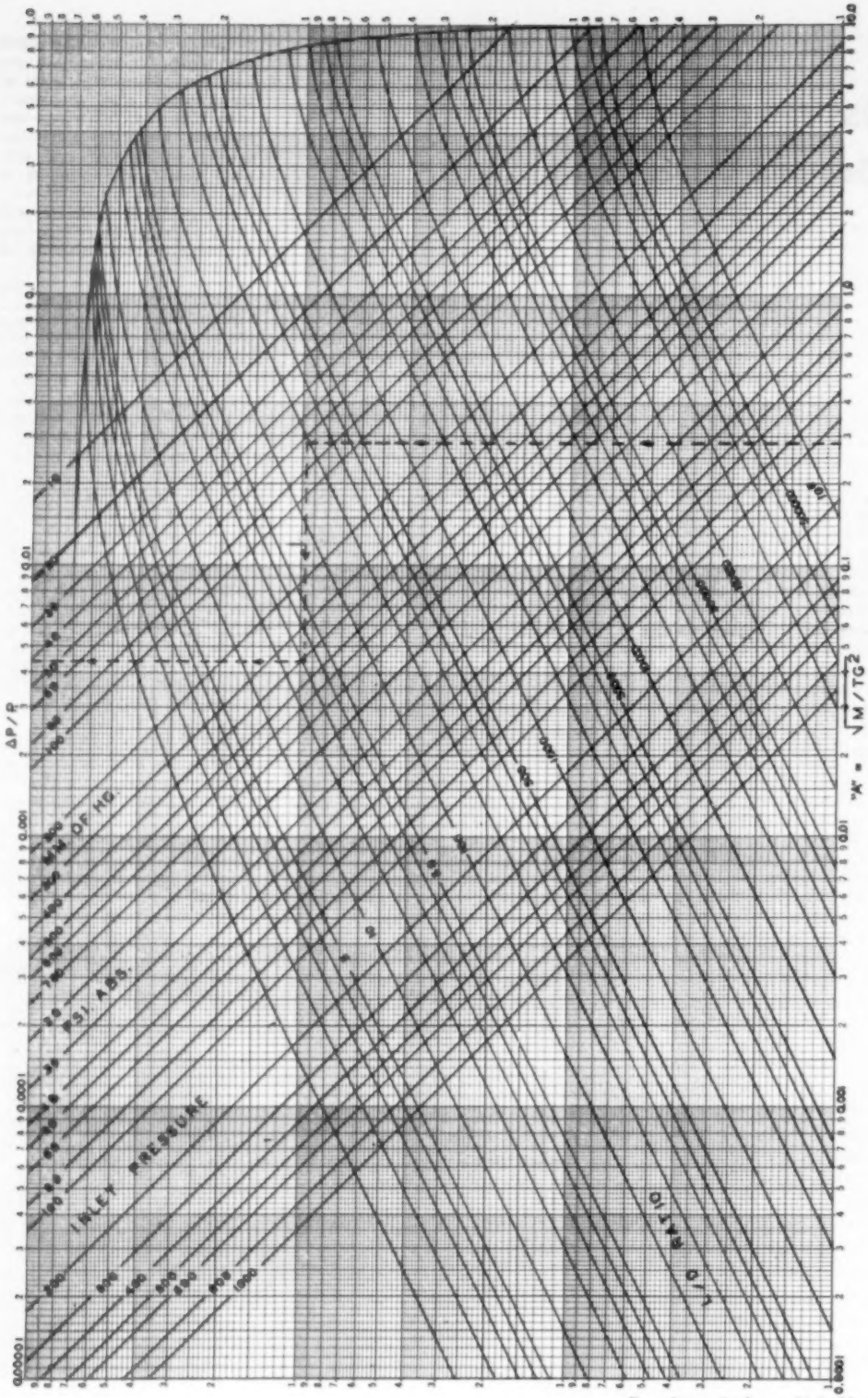
$$\left(\frac{L}{D}\right)' = \frac{f}{.016}\,\frac{L}{D} \qquad (4b)$$

Friction factor as used by Badger and McCabe[4]

$$\left(\frac{L}{D}\right)' = \frac{f}{.00025}\,\frac{L}{D} \qquad (4c)$$

When substantial deviation from the ideal gas law exists, Equation 1 should be integrated, taking into account compressibility factor and its variation with pressure. This has been done by Clinedinst[5] and the integration presented as a function of reduced coordinates. When the compressibility factor does not vary greatly, however, the correction due to deviation may be obtained by multiplying $\frac{\Delta P}{P_1}$

(Text continued on page 160. Note intervening figures.)


ΔP/P
"K" = √M/TG2
FIGURE 1
INLET PRESSURE
PSI ABS.
DP IN. HG
D/d RATIO

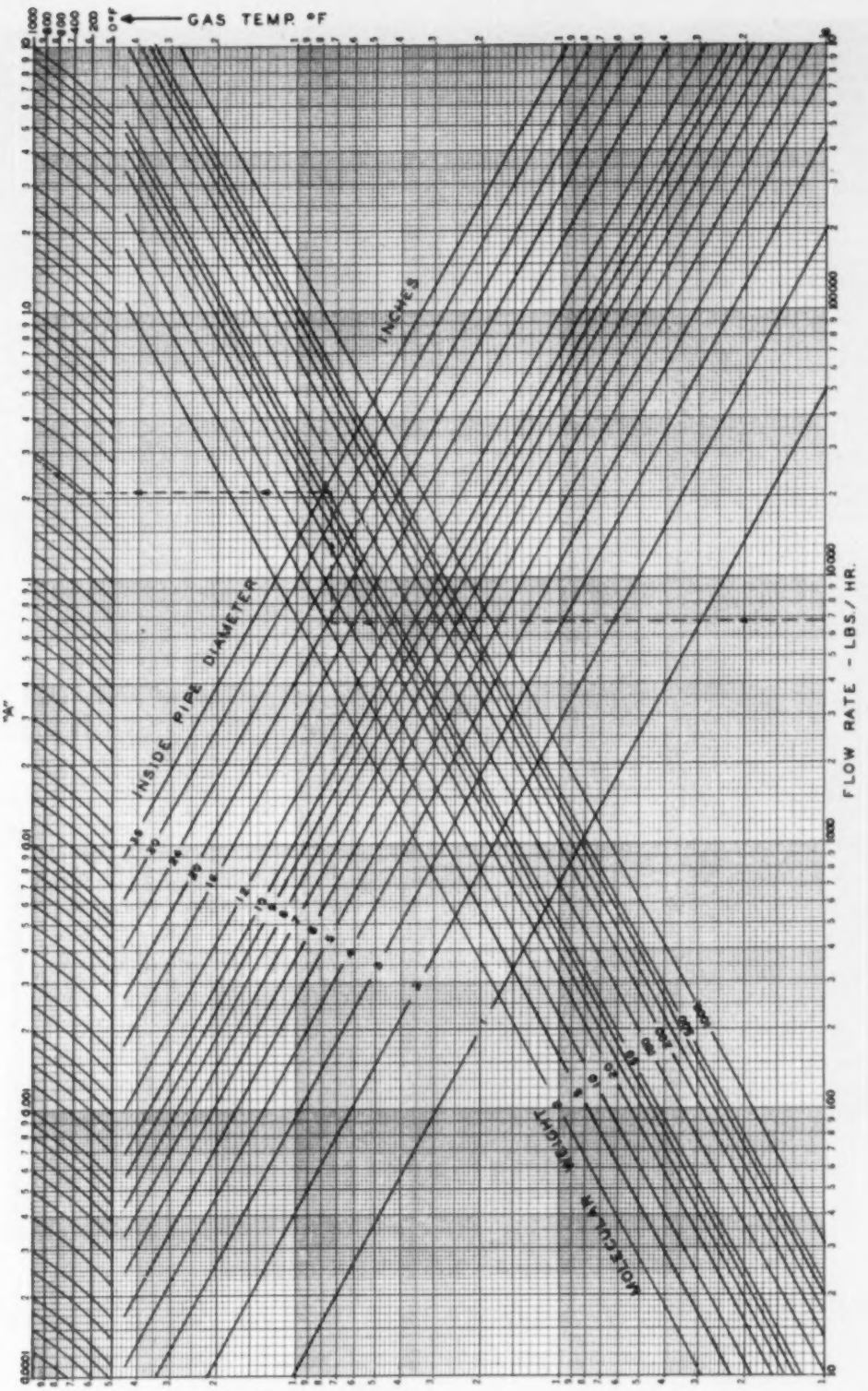

GAS TEMP. °F
INSIDE PIPE DIAMETER
INCHES
"A"
FLOW RATE - LBS./ HR.
MOLECULAR WEIGHT

FIGURE 2

as obtained from the charts by the average compressibility factor.

In reading Figure 1, the lines must never be extrapolated into the upper right hand corner above the curve. This is an imaginary region and no flow can occur past the termination of the L/D lines.

Examples which will serve to illustrate the method of using the charts follow:

Example 1. A vacuum tower is to operate at 66 mm. absolute pressure and 335° F. at the top of the tower. The overhead line is to carry 2025 pounds per hour of steam, 4695 pounds per hour of a 33-API gasoil, mol. wt. 270, and 30 pounds per hour of a 29 mol. wt. gas. The overhead vapor line is 19.35 inches i.d. and is 50 feet long. What pressure drop would be expected in the vapor line?

Solution. Pounds per hour overhead = 2025 + 4695 + 30 = 6750

Average Mol. Wt. =

$$\frac{6750}{2025/18 + 4695/270 + 30/29} = 51.5$$

Pipe i.d. = 19.35"
Temperature = 335° F.
Inlet Pressure = 66 mm. of Hg.
L/D = 50 × 12/19.35 = 31.

Enter Figure 2 at 6750 pounds per hour, go up to a diameter of 19.35 inches over to a molecular weight of 51.5, then up to a temperature of 335° F. and diagonally upward to the top of the chart. Read $A = 0.28$.

Enter Figure 1 at $A = 0.28$, rise to a pressure of 66 m.., move horizontally to an L/D of 31, and then up to the top of the chart and read $\Delta P/P_1 = .0044$.

The pressure drop is .0044 × 66 = .29 mm.

By reversing this procedure and using the terminal of the L/D line it is possible to determine the maximum quantity this pipe can handle. In this case, assuming all other factors remain constant, the pressure drop would be .365 × 66 = 24. mm. and the maximum flow would be 31,000. pounds per hour.

Example 2. A gasoline plant handles 100,000,000 standard cubic feet daily of a 0.7 specific gravity natural gas. The gas leaves the last stage of compression at 750 psia. and the aftercooler cools it to 90° F. The line from the cooler to the absorber is 150 feet long. If 0.5 psi. pressure drop is allowed in this line, what size line should be used? The compressibility factor for this gas at line conditions is 0.85.

Solution. Due to the arrangement of these charts, this problem cannot be solved directly but needs a trial-and-error solution.

Pounds per hour of gas = 100,000,000 × 0.7 × 29/24 × 379 = 223,000 pounds per hour
Molecular weight of gas = 0.7 × 29 = 20.3
Line temperature = 90° F.
Inlet line pressure = 750 psia.
Maximum allowable $\Delta P/P_1$ = 0.5/750 = .000667

Trial 1. 16-inch i.d.
L/D = 150 × 12/16 = 112.5
$\Delta P/P_1$ = .00021
ΔP = .00021 P,Z = .00021 × 750 × .85 = .134 psi.

Trial 2. 14-inch i.d.
L/D = 150 × 12/14 = 129
$\Delta P/P_1$ = .0004
ΔP = .0004 × 750 × .85 = .255 psi.

Trial 3. 12-inch i.d.
L/D = 150 × 12/12 = 150
$\Delta P/P_1$ = .00085
ΔP = .00085 × 750 × .85 = .54 psi.

The 14-inch i.d. meets the requirements but the 12-inch i.d. line comes so close that it might be used.

* * *

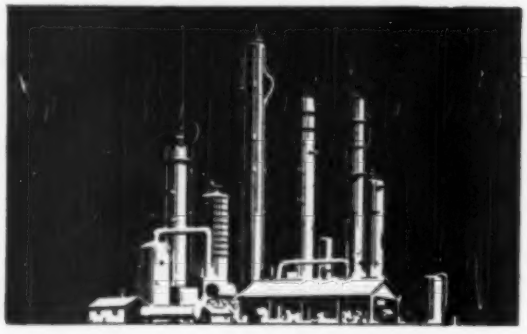
Example 3. A 12-inch i.d. pipe line is designed to handle 50,000,000 standard cubic feet daily of a 0.6 specific gravity natural gas. The line is 20 miles long, average temperature 80° F., and inlet pressure 500 psia. Estimate the outlet pressure.

Solution. Rate of flow = 50,000,000 × 0.6 × 29/24 × 379 = 95,600. pounds per hour.

Mass velocity = 95,600/0.785 = 122,000 lbs./hr.-sq. ft.
Molecular weight of gas = .6 × 29 = 17.4
Line temperature = 80° F.
Inlet pressure = 500. psia.
L/D = 20 × 5280 × 12/12 = 105,600.
Approximate gas viscosity = .0125 cp
Reynolds' Number = 12 × 122,00/12 × .0125 × 2.42 = 4,030,000.
Friction factor from Moody = .013
(L/D)' = 105,600 × .013/.016 = 86,000.
A = .0053
$\Delta P/P_1$ = .26
ΔP = .26 × 500 = 130 psi.
Outlet pressure = 500 — 130 = 370. psia.

An approximate correction for compressibility factor can be made by reading the compressibility at the average line pressure, 435. psia, and at the line temperature of 80° F. The value of this factor is 0.93.

Corrected pressure drop = 130 × .93 = 121. psi.
Corrected outlet pressure = 500 — 121 = 379. psia.



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[5] Cllnedinst, W. O., "Flow Equations for Gas Considering Deviations from Ideal Gas Laws," The Oil and Gas Journal, April 7, 1945.

From Nature's Gas Wells to Man Made Storage

WITH the rapid expansion of natural gas pipe line facilities, many public utilities are considering the use of underground, high pressure storage as the most economical and practical method of maintaining a readily available reserve for use under peak demand conditions or in case of failure of long distance pipe lines. Stone & Webster Engineering Corporation has designed and constructed seven underground gas storage fields which vary in capacity from 1,500,000 cubic ft. to 120,000,000 cubic ft.

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REFINER AUTHORS and Other Personalities

Information, formal and otherwise, about the men who write for PETROLEUM REFINER as well as others prominent in the industry.

J. C. HANNAH | A. M. WHISTLER | F. G. CRAWFORD | BERT J. THOMPSON | LEON DORSEY

Fluor Engineer Trio Outlines Chico Plant

Three top-notch process design engineers, Franklin G. Crawford, Joe C. Hannah, and A. M. Whistler, of The Fluor Corporation, Ltd., present a comprehensive discussion on "Rich Oil Dethanization Used as Process Scheme in New Chico Plant," beginning on page 117 in this issue. For two of the trio this is a second appearance among PR authors. Hannah's "Fractionating Absorbers in the Petroleum Industry" was published in August, 1949, whereas Whistler's "Heat Exchangers as Money Makers" was published in January, 1948.

Franklin G. Crawford, senior engineer, was graduated from California Institute of Technology with a bachelor of science degree in mechanical engineering. He joined Union Oil Company in 1930 and worked as refinery engineer on plant testing, including boilers, operation studies on thermal cracking and visbreaking units, and depreciation studies for cracking and distillation units. Later, as a process engineer with Union, he was concerned with plant startups of cracking, reforming, gas treating, etc.

Crawford joined Fluor in 1942. He has been project engineer in charge of refinery projects of HF alkylation, catalytic cracking, isomerization and gas concentration units, boiler and power plants, and vapor recovery units. In the natural gas-gasoline field, he worked as project engineer in charge of absorption, pressure maintenance and natural gasoline plants. He has served as project engineer for crude stabilization, oil and grease compounding plants, and a catalyst manufacturing plant. He is a licensed mechanical engineer in the State of California.

Joe C. Hannah, process engineer, received his bachelor of science degree in chemical engineering from the University of Oklahoma. With Shell Oil Company, Inc., which he joined in 1941, he received training in petroleum refining at the Deer Park refinery in pilot plant design and operation and general technological work. Transferred to Shell's New York office, he also did research and development work on refining processes. For several years he did process design work on fractionation, catalytic cracking, acid alkylation, isomerization, polymerization, liquid and gas treating, hydrogenation, desulfurization, lube oil processes, production of aromatics and special solvents and hydrochlo process.

In 1947 he came to Fluor as process engineer. He has worked on gasoline, LPG, gas treating, and potash plants. Also, he has been process and project engineer on gasoline, bromide salts, and ammonium bicarbonate plants.

Hannah is a member of the AIChE and a licensed chemical engineer in California.

A. M. Whistler, assistant chief process engineer, is a graduate of California Institute of Technology, 1922. In 1926, he went to work for C. F. Braun & Company, and as process engineer did development and design work on all types of plants for the petroleum industry.

He became chief engineer of Braun with administrative duties on development of design methods for absorption, fractionation, heat exchange and fluid mechanics; and plant designs for combination topping and cracking units, natural gasoline plants, light ends recovery, isomerization, polymerization, crude stabilization, vacuum distillation, and other processes.

Whistler joined Fluor as assistant chief process engineer supervising process design on absorption plants, special engineering on design of bubble columns, and other work on general petroleum refinery design.

Whistler, likes to help young engineers under his supervision achieve sound technical training. Although his long suit is mathematics, and his articles sometimes require rather complex figures, he has the rare ability of bringing a complicated subject right down to earth for the boys. He is a member of the ACS, ASME, AIChE, CNGA, and American Association for the Advancement of Science. Also, he is a licensed chemical engineer in California.

Thompson Describes Hawkins Extension

Bert J. Thompson, process engineer, contributed the article beginning on page 111 of this issue, "High Extraction Efficiency and Increased Capacity Effected by Hawkins Plant Extension."

A native of Arkansas, Thompson attended junior college at Arkansas Polytechnical College, Russellville, and then Oklahoma A. & M. College for his bachelor of science degree in chemical engineering in 1939.

For three and a half years after graduation he was employed by Phillips Petroleum Company in the Texas Panhandle as a junior manufacturing engineer in the natural gasoline department. Transferred to the general offices at Bartlesville, Okla., he spent the last half of seven years with Phillips as a manufacturing engineer.

In November of 1946, he joined the gas development section of the Stanolind Oil and Gas Company as a chemical engineer. He has been with Warren Petroleum Corporation as process engineer in the manufacturing department for the past two years.

Although he does not pursue any hobbies intensively, he does enjoy making weekend trips around the country with his family. During the spring and summer he likes an occasional golf game and fishing excursion on the local lakes.

New McCarthy Plant

Leon B. Dorsey, operations superintendent for McCarthy Chemical Company at Winnie, Texas, believes the most important men in a gasoline plant are the operators—they are the ones who make the plant work. His article "Gasoline Plant Supplies Naphtha for Catalytic Reforming Unit," begins on page 97.

Dorsey, better known by the nickname of "Huck" to his operators, was born in Port Arthur, Texas, in 1914, and at-

PAUL BUTHOD C. W. FRANK E. CLARENCE ODEN G. R. JONES W. J. BURCH, JR.

tended grammar and high school there. After completing two years at Lamar College in Beaumont, Dorsey enrolled in the University of Texas and obtained his bachelor of science degree in petroleum engineering in 1939. Since his father, E. L., worked at the refinery of Gulf Oil Corporation in Port Arthur (nearly 40 years at present) and he had worked in the refinery during summer vacations before and during college, Dorsey's first job was in Gulf's laboratory at the refinery.

Four years later in 1943, he left Port Arthur for the Old Ocean refinery of J. S. Abercrombie as laboratory foreman. From the laboratory Dorsey went into process engineering.

In 1945 he joined Absorption Plant, Inc., now McCarthy Chemical Company, as plant chemist and process engineer. He became plant superintendent in January, 1948. With the addition of a reforming unit and the second gasoline plant, he became operations superintendent in September, 1948.

The Dorsey's have two boys—junior, 5 years old, and Grantland, one year. By way of hobbies, Dorsey says he and Mrs. Dorsey enjoy bowling and square dancing. His favorite picture is one of Mrs. Dorsey and the two boys, which he keeps on his desk.

He is an active member of AIChE and a registered professional engineer in Texas.

Heavy Homework

Paul Buthod, associate professor in refining at the University of Tulsa, says he used to play tennis and ice skate for recreation, but recently all his spare time has been employed in planning additions to his house and making needed repairs. Buthod's article beginning on page 157 of this issue is entitled, "Pressure Drops in Gas and Vapor Lines."

Professor Buthod was born and reared in Tulsa. Receiving a bachelor of science in refining in 1939, he went to work for The Pure Oil Company in the laboratories north of Chicago. His work consisted of pilot plant operation and gas analysis. But with the tune, "Take Me Back to Tulsa" in mind, he was persuaded to return to the university on an Ethyl Corporation fellowship. He received his master's degree in 1942. Such then, he has been a member of the chemical engineering and refining departments of the university. In addition to teaching, he has done some consulting work in heat transfer and in liquefied petroleum gas.

Mr. and Mrs. Buthod have three youngsters, Mary, Ellen, and Ruth, ages 5, 4, and 2, respectively.

He's a Movie Maker

Charles W. Frank, chief engineer, Walco Engineering and Construction Company, Tulsa, reports that his three-year old daughter, Patricia Jean, is the leading lady of all his amateur movies. He has between 2500 and 3000 feet of film to prove this fact. Frank's article, page 123, and is titled "Magnolia Controls Residue Gas Btu. in New Plant."

Frank was born in Turon, Kan., in 1916, and after attending high school there, enrolled in Kansas State College, Manhattan. Three years later, he enrolled in Oklahoma University at Norman, but with only a few hours to go for his degree, poor health and equally poor finances forced him to quit school.

He went to work in 1938 on the labor gang for Skelly Oil Company. He worked at construction and operation of plants in the natural gas-gasoline engineering department and became chief engineer in charge of processing and construction in 1942.

In 1946 he joined Walco as chief engineer in charge of engineering and construction of all plant work from estimates and contracts to operation. Frank says he enjoys his work and that it amounts to a second hobby, although he does like fishing.

He is a member of the Engineers Club of Tulsa, NGAA, Petroleum Industry Electrical Association, and Masonic Lodge.

Alkylation Article by Cities Service Men

"Propylene—A Valuable Feed Stock for Alkylation," the article beginning on page 103 of this issue of PR, was written by three process engineers, E. Clarence Oden, chief process engineer, and Guy R. Jones and William J. Burch, Jr. All three men are located at Cities Service Refining Corporation's Tutwiler refinery at Lake Charles, La.

E. Clarence Oden, chief process engineer for Cities Service Refining Corporation, received his bachelor of science and master's degree in chemical engineering from the University of Alabama and Polytechnic Institute of Brooklyn, respectively. His graduate work was at Cornell and the University of Michigan.

His experience as a chemical engineer includes five years in pigments, paints and rubber, five years teaching chemical engineering in mid-western universities, one year during the war in the production of magnesium from dolomite and six years in petroleum refinery operation and process design work.

Oden is listed in "Men of Science" and "Who's Who in Engineering."

William J. Burch, process engineer in the Tutwiler refinery, is a chemical engineering graduate of Texas A. & M. 1942. After serving in the army, he worked for six months in the control laboratory of a major oil company, 18 months in a Gulf Coast chemical plant, three years in a butadiene plant, and for the past three years has been assigned to the process control and test section of the process engineering department.

Guy R. Jones, process engineer at the Tutwiler refinery, attended Louisiana Polytechnic Institute. He was graduated in 1944 with a bachelor of science degree in chemical engineering, and joined Cities Service as a laboratory analyst. After serving in the navy, he returned to the company and did pilot plant correlations work. He has been a member of the process engineering department, assigned to the alkylation units, for the past two years.

Started at Age of 14

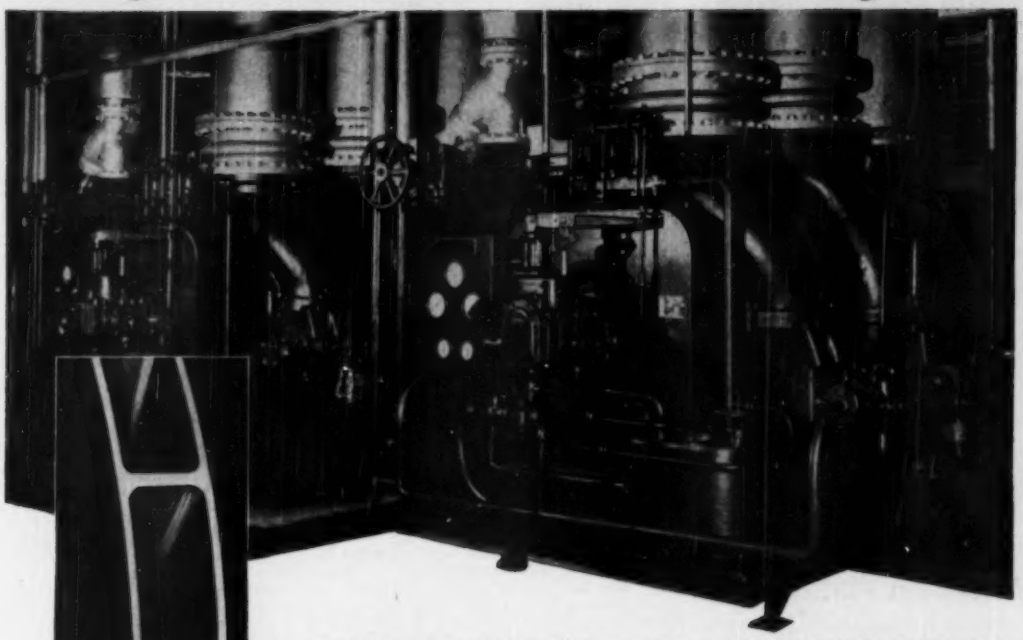
Albert J. McIntosh, economist for Socony-Vacuum Oil Company, Inc., New York, started to work in the petroleum industry as an office boy for Socony in 1912 at the age of 14. His article in this issue, "Fuel Oil Markets, Past and Future," begins on page 77.

McIntosh completed his high school and college education by attending night school. He was graduated in 1923 from New York University, a bachelor of commercial science, cum laude.

When the war rolled around in 1917, McIntosh was given leave by Socony to work in the petroleum division of the Fuel Administration. The next year he entered the army, serving in the coast artillery. After returning to the company, he enrolled in New York University.

During the NRA days, he served as a member of the Statistical Committee of Planning and Coordination Committee. Then in World War II, he served as a member of the Petroleum Economics Sub-Committee of the Petroleum Industry War Council and as chairman of the

Big blowers for a vital job



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Dr. Haensel in his laboratory.

East Coast Fuel Oil Advisory Committee of the OPA.

McIntosh is author of several papers for the AIMME. He has also been active in the API, and presently is serving as chairman of its Statistical Advisory Committee. He is a member of the recently organized Economic Advisory Committee of the Interstate Oil Compact Commission.

Needless to say, McIntosh is a frequent and popular speaker at technical and trade association meetings. He was enjoying himself at the WPRA gathering in San Antonio last month—enjoying Texas. "When I get into another part of the country, I like to see as much of it as possible," he declared.

Writes on Platforming

Vladimir Haensel, co-ordinator of the cracking research division of UOP since August, 1945, is the author of the article on "Platforming" begins on page 131. He joined UOP, after receiving his masters degree from Massachusetts Institute of Technology, to assist Professor V. N. Ipatieff. His bachelor's degree, Haensel received from Northwestern University in 1935.

In 1939, Haensel assisted in setting up the Ipatieff High Pressure Laboratory at Northwestern University. He received his Ph.D from Northwestern in 1941, and returned to Universal as a research chemist.

Haensel was a member of the Technical Oil Mission for PAW, and inspected the German synthetic oil plants from February to July, 1945.

Haensel's discussion of the Platforming process at the recent WPRA meeting in San Antonio drew a large attendance, and the interest of this group was evidenced by many questions on details of the process and its applications. And he had all the answers.

Corrosion in MEA Purification Units

The article, "Corrosion Problems in Gas Purification Units Employing MEA Solutions," which begins on page 141 was written by two members of the research and development department of The Fluor Corporation, Los Angeles. This is an article that will be perused with interest by a large number of gas purification engineers, whose worries include the reboiler tubes in the MEA unit.

Fred C. Riesenfeld is a native of Austria. His formal education began at the University of Vienna where he received the equivalent of a bachelor's degree in chemistry in 1938. After spending several years at the University of Paris (France) in biochemistry research, he arrived in the United States in 1941. He joined Harold S. Simons, Inc., New York in 1942 to work in production control and development of organic chemicals.

In 1944 he became connected with Fluor as research chemist. Presently, his activities are concerned with research on gas treating processes, development of analytical procedures, corrosion research and general chemical research in the field of gas-gasoline operations. He is a member of ACS.

Clyde L. Blohm, assistant director of research and development, obtained his bachelor's and master's degrees at the California Institute of Technology in 1930 and 1931, respectively. Following his graduation, he was employed consecutively by Canada Dry Gingerale, Inc., Chemical and Research Corporation, American Potash & Chemical Corporation and Maier Brewing Company in the capacity of chemist and chemical engineer. He joined Gordon A. Alles, Ph.D. in 1936, where he was active in research on synthetic pharmaceuticals, and pharmacology. He joined Fluor in 1942.

Under his supervision, research has covered a large number of problems—desulfurization and dehydration of hydrocarbon gases, studies of hydrocarbon hydrates, corrosion resistance of metals, evaporative water cooling, general wood chemistry as applied to cooling towers and development of equipment such as Fluor pulsation dampeners, gas cleaners, mufflers, etc.

He is a member of ACS and NACE.

Team Up on 'Type A'

Two automotive engineers—J. L. McCloud from Ford Motor Company, and H. R. Wolf, General Motors Corporation, have teamed to present the article beginning on page 153, "Automatic Transmission Fluid, Type A, for Passenger Cars." Wolf is assistant to the technical director of the Research Laboratories Division of GM in Detroit and McCloud has been a member of the Chemical Engineering department of Ford at Dearborn since 1915.

Wolf wasn't so keen about having his picture printed on the author's page although he did finally agree to a photo which the reader will find hereabouts. But, as you will soon determine, there was no biographical material to support said picture. His collaborator, McCloud, said "ixnay" to a photo "since the article is so extensively Wolf's," but he did advise that he had been with Ford in the chemical engineering department since 1915 which should qualify him as something of an old-timer.

The Wolf-McCloud article is a presentation of the requirements for the modified 1950 automatic transmission fluid, type A, and an enumeration of the technical reasons for these requirements. The discussion is intended to answer many questions that are being raised by the refiners and marketers who are not familiar with the development of automatic transmission fluids.

FRED C. RIESENFIELD CLYDE L. BLOHM H. R. WOLF A. J. McINTOSH

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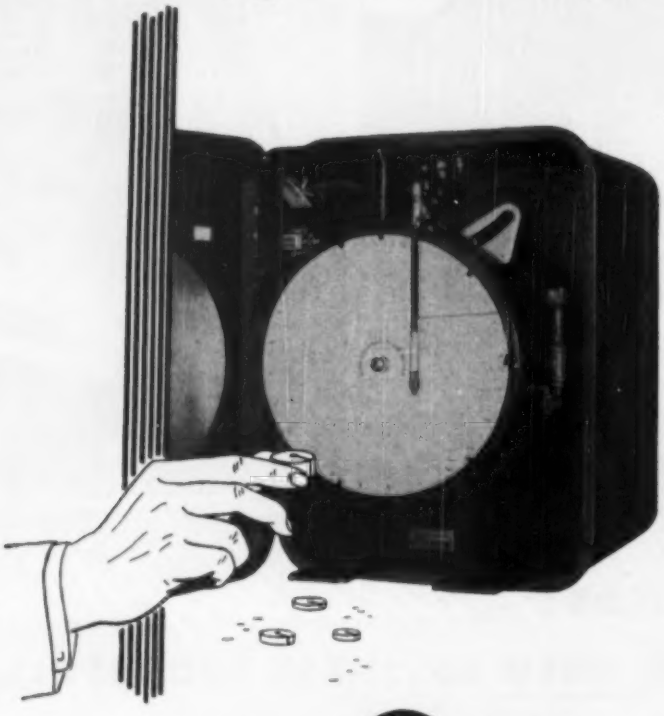

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You *can* calibrate or check Hagan Ring Balance Meters by the traditional water column method if you wish—but it isn't necessary.

It is far quicker and easier to use the set of standardizing weights furnished with each meter—and the results are the same.

Simply equalize the meter, hang the check weights on the sheave cable, (see illustration) and compare the resultant pen readings with the corresponding calibration values. Each check weight is stamped with its correct value.

For full information on this and other features of Hagan Ring Balance Flow Meters write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pennsylvania.

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Maintenance and Operation

HOW TO DO IT

HOW TO—

Determine Saybolt Second Values

IN THE control laboratory of the Lubrication Division of McColl Frontenac Oil Company, Toronto, a time-saving graph has been adopted for converting the efflux time of a kinematic pipette in seconds as measured by stop clock directly into Saybolt Seconds Universal. The graph was prepared by Arnold C. Chadwick.

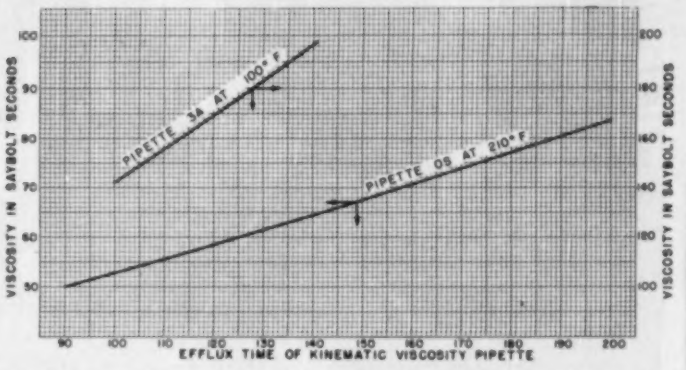
The previous method involved determination of centistokes by multiplying efflux time by a factor, and looking up the corresponding value in an A.S.T.M. conversion table.

With the use of this graph, the SSU value can be read immediately.

e.g. Tube OS 155 sec. running time is equivalent to 69 SSU.

Tube 3A 122 sec. running time is equivalent to 172 SSU.

Advantages are rapidity and elimination of arithmetical error. A rectangle of cardboard with a square corner will serve as a convenient eye-guide in reading the curves.



THE HOW OF—

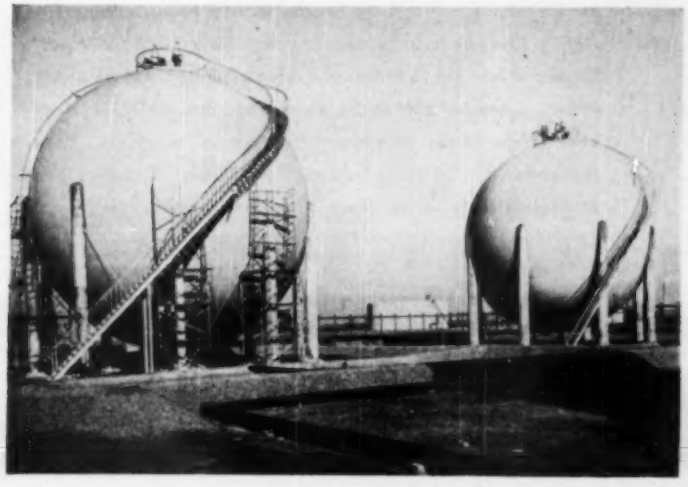
Applying Fireproofing Cement to Tank Columns

THE use of fireproofing cement coating of structural steel in refineries to retard the effect of heat and prevent failure of the steel as a safety measure in case of fire, is generally accepted practice. Application is made usually by troweling a layer of the cement over a ribbed metal lath with which the column has been wrapped. Light in weight, the cement is easily and simply applied.

The accompanying photograph illustrates the method of applying fireproofing cement to the I-beam columns supporting spherical butane tanks to result in a round column. Workmen clamp, or weld when possible, three-eighths-inch thick strap iron rings, three to four inches wide to the column, usually on 8-inch centers. Fire stops are included on 24-inch centers to eliminate flue action. The column is then wrapped with metal lath and the fireproofing cement troweled on and smoothed.

At the top of the column, where it is welded to the sphere, a tight joint between the fireproofing cement and the tank is necessary to prevent entrance of water behind the cement. This material remains plastic and provides a watertight seal between the steel of the tank and the cement. After the cement has hardened, it may be coated with flame-resistant paint, usually aluminum for improved appearance.

Photograph and material, courtesy Eagle-Picher Company, Cincinnati.

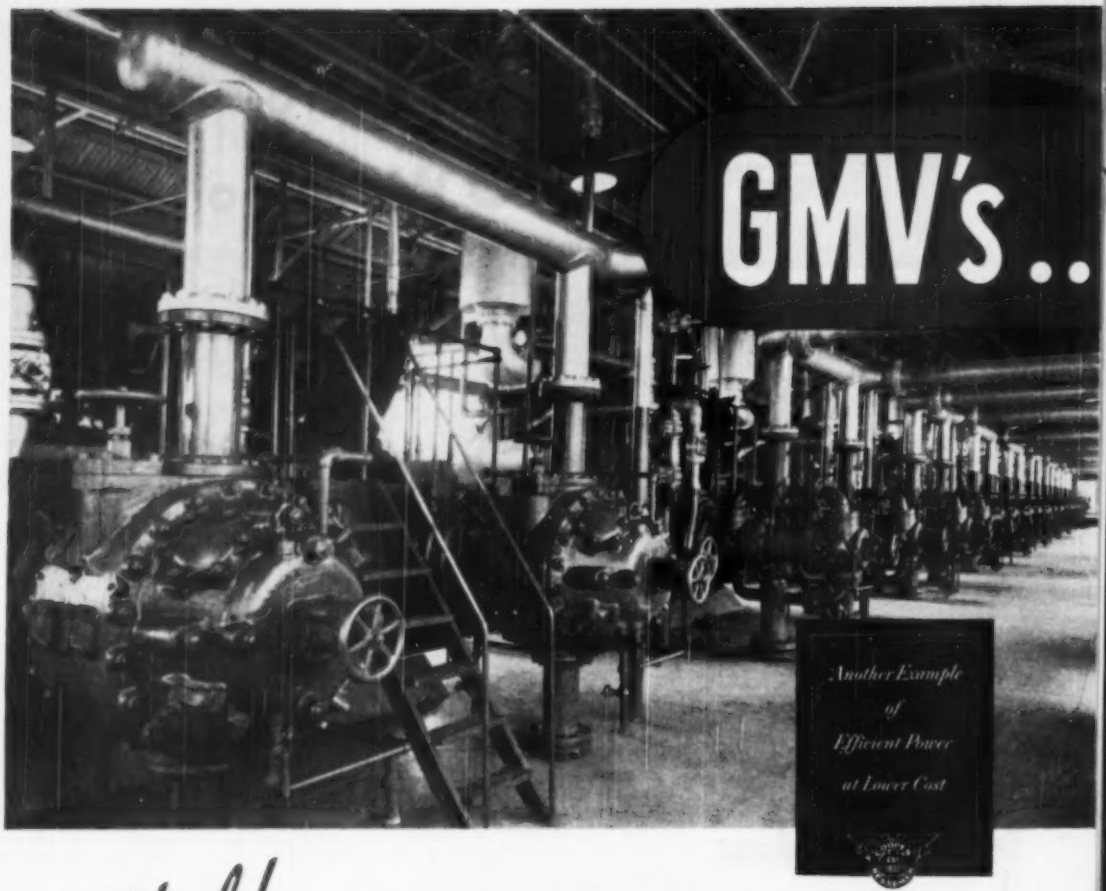


HOW TO—

Store Metals and Alloys

IN order to stock some 2600 different items, as in Gulf Oil Corporation's research laboratory stock room at Harmarville, Pa., considerable attention must be given to the storage methods used for the items. The Gulf stock room carries a highly diversified supply of materials to support the thousands of experimental jobs undertaken yearly. Phosphor bronze, beryllium copper, stainless steel, invar and elvinvar are among the scores of metals and alloys forming the stock room rack pattern of the photograph.

Since requests for materials usually are for "one-of-an-item," variety of types and shapes, rather than quantity governs the materials stocked. To facilitate selection of the metal desired, each shelf of the rack is marked with the name of



World Premier...

Eleven years ago, the first three Cooper-Bessemer GMV's ever built were installed in the Royalite Oil Company's Compressor Station No. 1 at Turner Valley, Alberta, Canada. Shown above as it is today, the station now contains ten GMV's. Elsewhere, as in this plant, familiarity with GMV performance has led to more and more of these units as needs grew . . . has led also to the widespread use of GMV's wherever large scale compressor service is involved. Thus the popularity of these efficient, long-lived V-angles has multiplied through the years. It speaks for itself.

ANGLE

Compressors

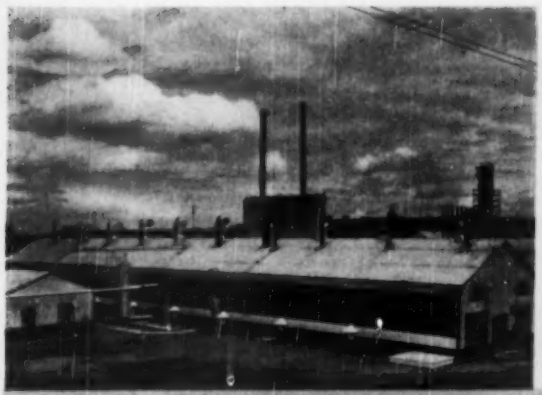
New York Washington Bradford, Pa. Parkersburg, W. Va. San Francisco, Cal. Seattle, Wash.

..11-year choice at Royalite Oil

ROYALITE Oil Company's three 11-year-old GMV's, the first ever built, are still in continuous service; have held up so well that visitors can't tell them from the seven since added to this company's No. 1 station as needs grew. Royalite's other two stations are likewise equipped with Cooper-Bessemer V-angles, Type GMV and the smaller GMX. The most recent addition to station No. 1* is a GMV *Turboflow*, installed this past summer. It gives Royalite unprecedented advantages—a full 10% increase in power output compared with other units of equal displacement, plus at least a 15% reduction in fuel consumption.

If your plans call for compressor horsepower, bear in mind that Cooper-Bessemer Turboflow V-angles, GMX, GMV and GMW, are now available in sizes from 200 to 2500 hp. Check on the savings you can show!

** Station No. 1 is now owned by Madison Natural Gas Company, Ltd., a totally owned Royalite subsidiary.*



Royalite Station No. 1 containing nine 6-cylinder 600 hp GMV's and a 6-cylinder 900 hp GMV Turboflow, for a total 6,900 compressor horsepower.

Interior view of station showing line of Cooper-Bessemer GMV-6 compressors from crank-door side. Compressor side of line shown on opposite page.

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the metal. The shelves are divided to separate the different shapes and sizes of the material; for example, round bars are stored according to diameter, and are in separate racks from square or flat bars.

Use of this type storage rack simplifies and speeds selection of materials, inventory for replacement, and eliminates waste.

HOW—Fountain Device Promotes Safety

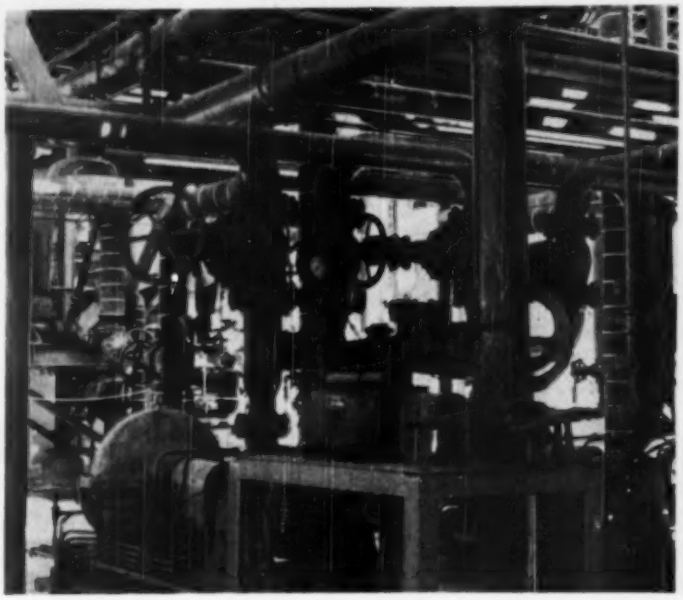
Numerous safety devices are employed in the grease and packaging plant of Standard Oil Company of California. The device pictured above is an eye wash fountain. It contains a special solution to neutralize chemicals in case of an accident. The valve is opened when the person using the fountain steps on the large grid-type base. Two heads are used on the fountain to spray the solution into both the accident victim's eyes simultaneously.

HOW TO—
Provide Emergency Lubricator Drive

WHEN the force feed lubrication unit in use on a particular piece of machinery must be removed for repairs, the usual procedure is to shut down the equipment and start up auxiliary or standby equipment. In many cases, however, standby equipment is not available, which requires that a new lubricator unit be installed while the machinery is in use.

The maintenance department in one refinery has developed a standby, or substitute, lubricator unit for use during the time the main lubricator is being repaired. The substitute unit consists of a spare lubricator driven through a universal joint coupling by a handtool air motor. This equipment is bolted to a stand or table built for this use in the refinery welding shop of angle-iron and plate.

Connections from the substitute lubricator unit to the bearings and other lubrication points on the equipment are made quickly with copper tubing. The quick change prevents damage to the machinery from lack of lubrication, and permits repair work on the force feed lubricator unit without a shutdown.



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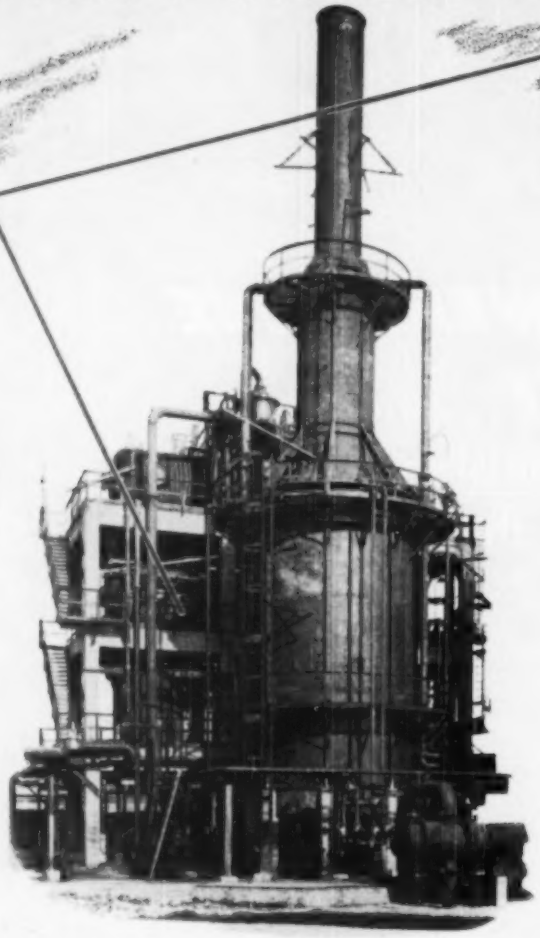

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The MONTH... in the INDUSTRY

F. M. Porter Named Tenth API President

Frank M. Porter of Oklahoma City on April 3 became the 10th president of the American Petroleum Institute, succeeding William R. Boyd, Jr. of Teague, Texas, who retired November 9, 1949, after holding the post nine years. Porter, 58, a native of Brooklyn, N. Y., is president and owner of the Fain-Porter Drilling Company of Oklahoma City, and has served as president of the Mid-Continent Oil & Gas Association for the past four years.

Porter

Baird H. Markham was named to membership on the board of directors, and appreciation was expressed for his service as acting president of the Institute during the interim between Boyd's retirement and the selection of a permanent successor. Markham will continue to serve as director of the American Petroleum Industries Committee, a post he has held for 17 years.

Porter's election to the API's top executive position was the unanimous action of the Institute's board of directors, according to W. Alton Jones, board chairman. Porter's was the only name submitted by the nominating committee, headed by Hines H. Baker, president of Humble Oil and Refining Company.

Porter indicated that he will assume the duties of his office at once and spend the majority of his time in New York at API headquarters. He will continue to maintain his residence in Oklahoma City, however, and will continue as head of the Fain-Porter Drilling Company. He will resign the presidency of the Mid-Continent Oil & Gas Association in due course, he said.

Porter's career in the oil business began in 1916, when he started as a warehouse employee for the Dundee Petroleum Company in Ardmore, Oklahoma. In 1918, he became associated with Wirt Franklin, poineer independent producer, and became vice-president in charge of production of the Wirt Franklin Petroleum Corporation in 1927, which post he held until 1940. In 1939, he formed, with Leslie Fain of Oklahoma City, the Fain-Porter Drilling Company.

"Revolution by Nibbling"

A crushing tax burden which ignores economies recommended by the Hoover report, security plans of questionable merit, and discrimination in granting tax exemptions were assailed as "revolution by nibbling" by Dr. Robert E. Wilson, chairman of the board, Standard Oil Company (Indiana).

"We must realize that an attack on the freedom of one industry or one profession is an attack on all," he said. "The battle of power companies against government duplication of power facilities is our battle, too."

Dr. Wilson last month spoke at the formal presentation of the permanent new oil industry exhibit at the Chicago Museum of Science and Industry.

API Announces Changes

Robert H. Stewart, of Hollis, N. Y., has joined the headquarters staff of the American Petroleum Institute as administrative assistant to the president. Stewart came to the API from California Texas Oil Company, Ltd., where he had been assistant to the vice president in charge of marketing.

Joseph H. Mader has been promoted to assistant director of the API department of information. Mader has been district representative for the Oil Industry Information Committee in the middle Atlantic district for the past three years with headquarters in Philadelphia.

Ernest E. Robinson, formerly director of public relations and personnel for the Don Allen Organization in Buffalo, N. Y., has been selected to succeed Mader in the Philadelphia office.

Another addition to the API staff is Jack McKenzie, assistant to James S. Haskins, supervisor of field operations. McKenzie, prior to his OIIC affiliation was vice president in charge of the eastern operations of James W. Irwin Associates, a public relations consulting firm.

WORLD'S TALLEST COOLING TOWER: The world's largest concrete cooling tower, rising to a height of 341 feet 6 inches from ground level will dominate the site of Shell's new Stanlow refinery, now under construction at Ellesmere Port, Cheshire, on the Manchester Ship Canal. Photo shows the new tower under construction, already dwarfing the existing cooling tower on the site.

Shaped like a giant milk bottle, the tower, in operation, will deal with 3 million gallons of water an hour, which will be used for cooling purposes in the refinery processes.

At its base the tower measures 272 feet in diameter, reducing to 168 feet at the neck and widening again to 177 feet at the top. More than 500 tons of reinforcing steel is being used in the construction and the total weight of the tower will exceed 20,000 tons.

The new refinery began to operate last December and is already handling crude oil at the rate of 7.5 million barrels a year. Together with its twin refinery now under construction at Shell Haven, near Southend, Essex, the new Stanlow refinery will handle annually 45 million barrels of crude oil, mainly from the Middle East.

Refining Section of API to Hear Many Technical Papers at Cleveland

Papers, in numbers greater than ever offered before at an API Division of Refining, mid-year meeting will be presented before seven technical groups at Cleveland May 1-4. Committee and subcommittee sessions will be held during the same period when something like 500 to 600 refining branch men from all parts of the country will be on hand.

Highlight of the meeting will be the open dinner session scheduled for the evening of Wednesday, May 3. Presiding will be Chester F. Smith, of New York, Standard Oil Company (New Jersey) who is API vice president for refining. Presentation of the John Scott award will be made at this dinner as will be several API certificates of appreciation. The principal address will be delivered by Sherman Rogers of Cleveland on the topic "Where Do We Go from Here?"

The program for the meeting follows:

MONDAY, MAY 1

1:30 p.m.—Symposium on Analytical Research: (Sponsored by the Committee on Analytical Research).

"Rapid X-ray Examination of High-Sulfur Cracked Distillates," Harold K. Hughes and John Wilczewski, The Standard Oil Company (Ohio), Cleveland; "Analysis of High-Sulfur Cracked Distillate," J. P. Wilson, Union Oil Company of California, Wilmington, Calif.; "Mass Spectrometric Determination of Traces of Sulfur Compounds in Synthesis Gas," J. H. Shively and F. Philgreen, The Texas Company, Beacon, N. Y.; "The Copper-Strip Test —A Study of Current Method of Interpretation and Examination of Proposed New Procedure," S. W. H. Matthews and P. G. Parsons, Anglo-Iranian Oil Company, Ltd., Research Station, Sunbury-on-Thames, Middlesex, England.

"Determination of n-Paraffins by Urea Ad-

The MONTH...

duct Formation," W. J. Zimmerschied, W. S. Hegley, and A. P. Lien, Standard Oil Company (Indiana), Whiting, Ind.; "Construction and Application of an Automatic Titrimeter," W. S. Young, The Atlantic Refining Company, Philadelphia; "Factors Affecting Precision Viscosity Measurements with the Torsion Crystal," F. E. Rouse, Jr., E. D. Bailey, and Jean A. Minkin, The Franklin Institute, Philadelphia.

TUESDAY, MAY 2

9:00 a.m.—Corrosion:

"Corrosion of Relief Valves," R. J. Hafsten, Standard Oil Company (Indiana), Whiting; "Cathodic Protection of Open-Box Coil-Type Condensers and Coolers," C. R. Draughon, A. B. McNeil, Esso Standard Oil Company, Baton Rouge, La.

2:00 p.m.—Training Supervisors:

(Sponsored by the Committee on Training)

Three papers on Training and Development of Supervisors will be presented.

WEDNESDAY, MAY 3

10:00 a.m.—Waste Disposal:

"Scrubbing Devices for Air-Pollution Control," E. P. Kropp, The Standard Oil Company (Ohio), Cleveland; "Administration of Public Law No. 845," Carl E. Schwob, Chief, Division of Water-Pollution Control, Federal Security Agency, Public Health Service, Washington, D. C.

"Operation of API Oil-Water Separator at Trenton Refinery," C. F. Miller, Socony-Vacuum Oil Company, Inc., Trenton, Mich.; "Use of Bacteria as Test Organisms in Stream-Pollution Studies," W. H. Hart, The Atlantic Refining Company, Philadelphia.

2:00 p.m.—Refinery Maintenance:

"Layout and Operation of New Shops—Houston Refinery," Robert Haldane, Shell Oil Company, Houston; "Maintenance Practices in a Small Refinery," John S. Pfarr, Leonard Refineries, Inc., Alma, Mich.; "Human Relations in Refinery Maintenance," R. L. Rude, Sun Oil Company, Philadelphia.

6:30 p.m.—Open Dinner Session:

Presiding: Chester F. Smith, Vice President for Refining (American Petroleum Institute); Standard Oil Company (New Jersey), New York.

Presentation of the John Scott Award and presentation of API Certificates of Appreciation. "Where Do We Go From Here?" Sherman Rogers, Cleveland.

THURSDAY, MAY 4

10:00 a.m.—Motor Fuels:

Presiding: D. P. Barnard, Standard Oil Company (Indiana), Chicago.

A paper on "The Constant-Volume Combustion of Diesel Fuels," R. E. Hurn, U. S. Bureau of Mines, Bartlesville, Okla.; "Methods of Estimating Cetane Number," Hobart D. Young, Sinclair Refining Company, Harvey, Ill.; "Effect of Sulfur in Motor Gasoline in Engine Operation (a paper based on a CFR report), J. B. Duckworth, Standard Oil Company (Indiana), R. E. Jeffrey, Shell Oil Company, and E. J. Gay, consulting engineer.

2:00 p.m.—Motor Fuels (continued):

Presiding: T. B. Rendel, Shell Oil Company, New York.

"Road Effectiveness of Lead as Influenced by Sulfur," Donald H. Pulleybank and W. J. Lovell, Ethyl Corporation, Detroit; "Effects of Hydrocarbon Structure on Road Knock Performance of Motor Fuels," T. D. Prickett, M. H. Campbell, and D. A. Knee, E. I. du Pont de Nemours and Company, Wilmington, Del.; "Platformate—Properties and Performance," J. S. Bogen and Vladimir Haensel, Universal Oil Products Company, Chicago.

Committee Meetings

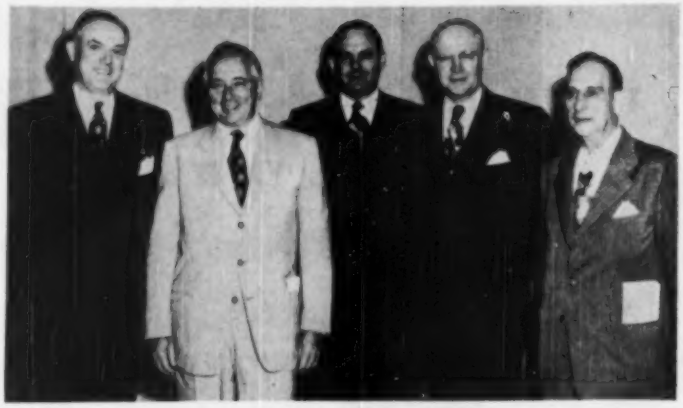
Committees and subcommittees will meet as follows:

Monday: Committees on Training, Automotive Research, Subcommittees on Nitrogen Compounds, Sampling and Testing, Mechanical Equipment, Manufacturers on Valves, Oil-Water Separation, Unfired Pressure Vessels and Manufacturers on Safety, Relief Valves.

Tuesday: Committees on Petroleum Product, Training, Advisory, Subcommittees on Chemical Wastes, Sludges and Clays, Instruments, Tank Accessories, Emission Spectroscopy, Waste Gases and Dusts, Electrical Equipment, Refinery Inspection Supervisors, X-Ray Diffraction, Oxygenated Compounds, Corrosion.

Wednesday: Committees on Program, Analytical Research, Disposal of Refinery Wastes. Subcommittees on Valves, Pressure-Relieving Systems, Electrical Equipment.

Thursday: Committee on Refinery Equipment. General Committee will hold Luncheon at 12:30 p.m.



OFFICERS OF WPRA—Officers were re-elected last month when the Western Petroleum Refiners Association held its annual meeting in San Antonio. Shown in the photo are, left to right: F. L. Martin, Sunray Oil Corporation, Tulsa, vice president; R. W. McDowell, Mid-Continent Petroleum Corporation, Tulsa, president; R. L. Tollett, Cosden Petroleum Corporation, Big Spring, Texas, vice president; Roland V. Rodman, Anderson-Prichard Oil Corporation, Oklahoma City, vice president, and John C. Day, secretary-treasurer. H. E. Zoller, Derby Oil Company, Wichita, Kan., also re-elected vice president, was not present.

All Officers Re-Elected as WPRA Holds Annual Meet in San Antonio

R. W. McDowell, Mid-Continent Petroleum Corporation, Tulsa, was re-elected president of the Western Petroleum Refiners Association at its 38th annual meeting held March 27-29 in San Antonio. Other officers, all re-elected at the meeting, which was attended by more than 500 persons, include vice presidents, F. L. Martin, Sunray Oil Corporation, Tulsa; Roland V. Rodman, Anderson-Prichard Oil Corporation, Oklahoma City; R. L. Tollett, Cosden Petorleum Corporation, Big Spring, Texas; and H. E. Zoller, Derby Oil Company, Wichita, Kan.; and secretary-treasurer, J. C. Day, Tulsa.

Highlighted in the technical sessions was Dr. Vladimir Haensel's discussion of the successful operation of the first Platforming unit at the Muskegon, Mich., plant of Old Dutch Refining Company. Platforming, a new catalytic reforming process for improving the octane rating of straight-run gasolines and naphthas, was developed by Dr. Haensel, who is coordinator of the cracking research division, Universal Oil Products Company, Chicago, and other UOP engineers. Gasoline ranging from 93 to 95.8 research octane, including 3cc. of tetraethyl lead, from charge stocks having leaded research octanes of about 68 have been produced at Old Dutch, according to Dr. Haensel's figures. Yields range from 90 to 94.5 volume percent. (See articles starting on pages 128 and 131 of this issue.)

"The Oil Industry Fights for Survival" was the topic of National Petroleum Council Chairman Walter S. Hallanan who urged the oil industry to remove the gloves and use bare knuckles in fighting the critics and government planners attempting to socialize the oil industry. Every step in this direction is disguised by the veneer of the phrase, "public welfare," Hallanan said. "Whenever the turning of a valve in Texas or Oklahoma or elsewhere has to await a directive from Washington, this nation will stand defenseless from the world." Regarding oil imports, Hallanan emphasized there is no security in foreign oil in any hour of national emergency.

Socony-Vacuum Oil Company, Ltd. Economist Albert J. McIntosh, whose address "Fuel Oil Markets—Past and Future" opened the three-day meet, advised refiners to prepare to obtain new all-time high yields of distillate fuel oils, particularly diesels, and gasoline from each barrel of crude oil to allow for inroads being made by natural gas into their fuel markets. Natural gas will be taking an even deeper bite into the market for fuel oils and kerosine during the coming three years than it has in the past, he predicted. "The probable sales of liquid petroleum fuels in 1953 may be only one percent above 1950. What will happen after '53 will depend largely on further developments in the natural gas field. Basing his conclusions on the recent and planned expansion in the natural gas industry which are certain to be far reaching with respect to liquid fuels, McIntosh suggested the industry pay more attention to effects of weather and utilize more effectively the degree-day system which permits calculation of additional demand or lack of it. (See further treatment starting on page 77.)

Reassurance was given refiners concerned about trends in the utilization of motor fuels in automotive transportation in the address of John M. Campbell, head of the General Motors Corporation organic chemistry department at the Detroit research laboratories division. With reference to improvements in engine design that might overnight invalidate refiners' investments in equipment to produce high octane gasolines, Campbell said, "It is a fundamental principle of engine design that high compression gives greater combustion efficiency. To be sure, there are other means of getting improved economy, such as lower

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The MONTH...

axle ratios, smaller engines, and transmission design. But high compression and high octane fuel can always be added to any improvements that can be made in these other directions."

President McDowell, in his address warned that if the oil industry should become complacent instead of fighting to the finish to halt the proposed depletion allowance reduction "we may very well be jockeyed into a disastrous compromise at the last minute." McDowell called attention to the additional and specific minimum wage levels in the oil industry proposed by the Department of Labor to act "as a club over those doing business with the government." The practical effect of this proposal, he said, may well be to exclude many small refiners from the field of government contracts.

A technical paper, "Progress and Trends in Petroleum Refinery Instrumentation" was presented by Douglas M. Considine, recently appointed manager of the market extension division, general sales of Brown Instruments Division, Minneapolis-Honeywell Regulator Company, Philadelphia. This discussion, constituted a rather detailed review of current practice in the automatic control of process units. It was noted that the percentage of capital investment for instruments in new plants now runs about 3 percent for solvent dewaxing plants, 4 percent for styrene and ethylene plants, 3.4 percent for catalytic cracking units, and 4.9 percent for gas recovery units. These figures compare with 1.5 percent instrument investment in textile process plants and 2 percent in average non-petroleum chemical processes. Considine also discussed developments in the field of graphic panel instrumentation, giving alternate solutions recommended by his company for typical plant cases. (See also "Evolution of the Graphic Panel in Automatic Process Control," by Louis Gess, application engineer, Brown Instruments Division, Minneapolis-Honeywell Regulator Company, Philadelphia, page 110, PETROLEUM REFINER, March, 1950.)

A technical discussion on "Modern Trends in Industrial Water Treating" was given by Dr. R. C. Ulmer, technical director, Power Chemicals Division, E. F. Drew & Company, New York.

"Oiling the Squeaks of Human Relations" was John L. McCaffrey's topic. McCaffrey is president of the International Harvester Company, Chicago. Luncheon talks were made by John S. Bugas, vice president in charge of industrial relations, Ford Motor Company, Detroit and Henry J. Taylor, radio news commentator, New York.

Texan to Organize Venezuelan Oil Statistics

H. J. Struth, petroleum consultant, Dallas, is newly assigned petroleum consultant to the Venezuelan government in Caracas where during the next three months he will organize a petroleum statistical department and will prepare an economic survey of the Venezuelan petroleum industry. Struth was assistant director of information for the American Petroleum Institute, economist and executive assistant of The Texas Mid-Continent Oil and Gas Association.

Heads Technical Division Gulf Oil Manufacturing

L. O. Crockett, former assistant general superintendent of Gulf Oil Corporation's refineries in Port Arthur, Sweetwater, and Fort Worth, has been transferred to general offices at Pittsburgh and appointed manager, technical division, of the manufacturing department.

Crockett

Crockett will supervise direction of the several refinery laboratories and the refinery technology division at Philadelphia. He also will serve as liaison of the manufacturing department in dealings with Gulf Research & Development Company and with the domestic and foreign marketing departments on questions relating to product quality.

A graduate of the University of Texas where he was an instructor, Crockett joined the Gulf companies in 1922 when he was employed as assistant chemist in the experimental laboratory at Port Arthur. Later he was foreman of the plant used in the manufacture of alchlor processed oils, chief chemist for the three Gulf refineries in Texas, and assistant general superintendent in charge of refinery laboratories and technology.

California Standard Plans Fuel Oil Output Relief

A marked refinery-wide reduction in the amount of heavy fuel oil produced and a substantial increase in the manufacture of gasoline are expected from Standard Oil Company of California's multi-million dollar program designed to relieve a growing over-production of heavy fuel oil in California. The plans include conversion of Standard's TCC unit at Richmond to a new refining process; construction at Richmond of a new vacuum tower capable of handling 50,000 barrels oil daily; and integration of many existing plants into the new processing program. Engineering work already has begun on the TCC unit, and the whole project is scheduled for completion by mid-1951.

The change in the TCC plant will increase the unit's coke-burning capacity 60 percent by enabling it to handle 500 tons of catalyst an hour, as compared with 150 tons per hour now circulated. The 26-foot diameter vacuum flasher, which will process heavy oil residue of other refining processes in the Richmond plant, will be the largest vessel in any of Standard's refineries.

NPC Meets April 26

April 26 has been set as the next quarterly meeting of the National Petroleum Council. On the preceding evening, NPC members and representatives of Interior's Oil and Gas Division will meet with Interior Secretary Oscar L. Chapman, as guest.

Southwest Research Opens Paris Office for Foreign Work

Establishment of an office in Paris, France, by Southwest Research Institute and its affiliated scientific organizations to facilitate handling of work for European companies and individuals is announced by Dr. Harold Vagtborg, institute president. Directed by M. Servan G. Cantacuzene, research engineer, the Paris office, located at 207 Rue de L'Universite, is the fourth established by the Texas industrial research laboratories, the others being in San Antonio, Houston and New York. Cantacuzene is a former research and consulting engineer for French and Rumanian oil companies. He was graduated from the Universities of Bucharest and Paris.

In addition to representing Southwest Research, which conducts industrial and agricultural research for companies, associations and individuals, the Paris office also handles European matters for the Institute of Inventive Research, serving manufacturers and inventors, and the Foundation of Applied Research, conducting fundamental scientific investigations in agriculture and medicine.

Corrosion Engineer Chosen For 1950 Whitney Award

"In recognition of his outstanding contributions to the science of corrosion," Robert H. Brown, chief of chemical metallurgy at Aluminum Company of America's research labs in New Kensington, Pa., has been chosen by the National Association of Corrosion Engineers to receive the international Whitney Award for 1950. Brown directs research on the chemical behavior of aluminum and magnesium alloys at the ALCOA labs.

A holder of many patents in the field of corrosion engineering, Brown was a pioneer in establishing the theory of cathodic protection and is an authority on the use of aluminum in specific environments. He was a graduate of Drexel Institute of Technology and also holds a master's degree in chemical engineering from the Massachusetts Institute of Technology where he was a research associate investigating corrosion mechanisms.

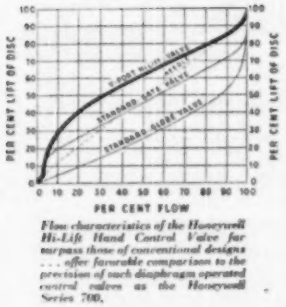
Co-Op Complains of Squeeze, Plans New Plant Expansion

Complete investigation of the oil industry to determine whether there is a real intention on the part of major oil companies to put the "squeeze" on the independent and co-operative refineries was urged last month at the annual meeting of the Midland Cooperative Wholesale.

It is impossible to show savings in refinery operation with crude oil prices remaining at same high level for more than a year while refinery prices of finished products have dropped, according to A. J. Smaby, Midland's general manager. Co-Ops and independents, he said, must place themselves in the same position as major oil companies, which own 85 percent of crude oil they refine, to halt losses on refinery operations.

Lummus Executives Named

Carl S. Reed, president of The Lummus Company since its beginning in 1930, has been elected chairman of the board. James F. Thorton, executive vice president, and with the company for the past 14 years, has been elected president.



Flow characteristics of the Honeywell Hi-Lift Hand Control Valve far surpass those of conventional designs . . . offer favorable comparison to the precision of such diaphragm operated control valves as the Honeywell Series 700.

THE Honeywell Hi-Lift Hand Control Valve is ideal for use where automatic regulation is not necessary or advisable. Designed to afford micrometer adjustment of flow, it contains an indicating scale to show percentage of stem travel to 1% and an inner valve capable of responding to such close correction. Inset illustration shows the simple and easy-to-read scale and the curve at left portrays the superior flow characteristics of the Hi-Lift over conventional valve designs.

The Honeywell Hi-Lift is available with v-port or parabolic discs . . . in sizes from ¼" to 12" . . . straight through or angle . . . for pressures up to 600 lbs. . . . with body of Bronze, High-Tensile Iron or Cast Steel . . . and with Bronze or Stainless Steel trim. Available, too, with electric motor for remote control applications.

Call in your local Honeywell engineer for detailed information about the Hi-Lift and such other Honeywell Process Control Specialties as: Transfer Valves, Liquid Level Devices, Cylindrical Plug Valves and the Honeywell Space-Saving Bypass.

Write, today, for a copy of Bulletin #242-1!

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WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL

Honeywell
DIAPHRAGM VALVES
AND PROCESS CONTROL SPECIALTIES

The MONTH...

The Lummus Company is designing engineer and constructor of petroleum refineries and alcohol plants.

Standard Oil Development Vice President Retires

Eric W. Luster has been named vice president of Standard Oil Development Company succeeding Nathaniel E. Loomis, retired, and also a member of the board. Loomis who has served 32 years with affiliates of Standard Oil Company (New Jersey) participated in the basic development of oil cracking methods and the introduction of pipe stills and other modern refining processes. He received his B.S. from Beloit College, M.S. in chemistry from Syracuse University, and Ph.D. in chemistry from Johns Hopkins University.

Luster

Luster joined Standard Development in 1916 and served with a company affiliate in Italy for several years after World War I. He has since been chief engineer and manager of the Esso Engineering Department. Luster received M. E. and E. E. degrees from Rutgers University in 1914.

Standard Firm Undertakes Atomic Eenergy Project

Standard Oil Company of California has formed California Research & Development Company to undertake a new research project for the U. S. Atomic Energy Commission in the San Francisco bay area. The new company is a wholly-owned subsidiary of California Research Corporation, Standard's research organization.

Officers of the new company include Fred Powell, president, formerly general manager of Standard's El Segundo refinery and J. Q. Cope, vice president, formerly chief engineer of Richmond laboratories of California Research.

Socony Committee Secretary

Wayne A. Howard has been appointed secretary of the manufacturing committee, Socony-Vacuum Oil Company, Inc., succeeding W. H. Zabriskie, retired. Zabriskie had been with the company since 1914.

McKee Technical Director

Andrew E. Chute has joined Arthur G. McKee & Company, Cleveland, as assistant technical director. He was formerly a senior process engineer with Foster Wheeler Corporation.

Stanolind Chief Engineer

Donald B. Edwards has been appointed chief engineer, manufacturing department, Stanolind Oil and Gas Company, succeeding A. J. Pettigrove, retired. Formerly chief gas engineer in the manufacturing department, Edwards has been with Stanolind since November, 1946, when he joined the company as assistant chief gas engineer. Edwards received his chemical engineering degree from Rice Institute.

Pettigrove has been head of Stanolind's gasoline plant construction program for the last four years.

Sunray's 2nd Straight Year

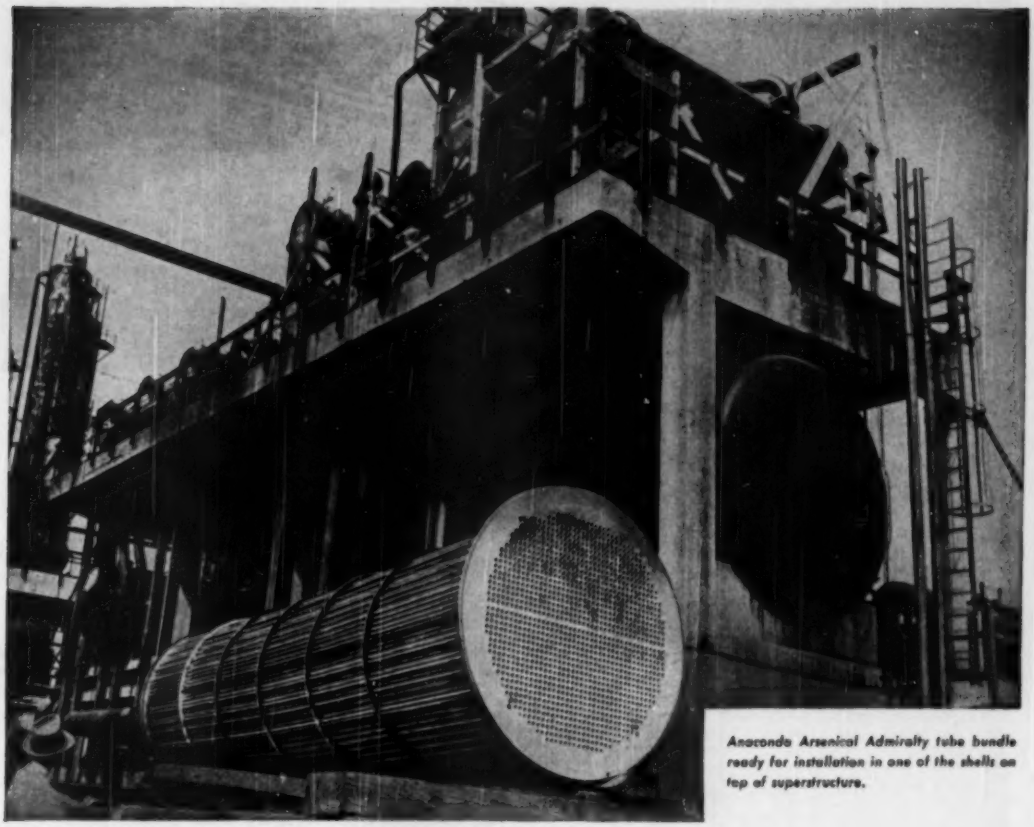
Sunray Oil Corporation's catalytic cracking refinery at Sunray, Okla., south of Duncan, began its second year of continuous operation without shutdown on March 7. The No. 1 cat cracker put the 3.6 millionth barrel of gas oil through, completing 365 days of running since going on stream last year, after a turnaround operation.

Foster Wheeler Names Mills As President and Chairman

Foster Wheeler Corporation, New York, has elected Vice Admiral Earl W. Mills, U. S. Navy (retired) president and chairman of the board. Admiral Mills joined Foster Wheeler early last year on his retirement from the navy as chief of the bureau of ships and was elected president of the corporation about six weeks ago following the death of Harry S. Brown. David McCulloch who has served the corporation and its predecessors since 1906, and who was recently appointed chairman of the board, requested retirement from active service and was elected vice chairman of the board. Geoffrey H. Hopewell, managing director of Foster Wheeler

THE OIL MAN'S CALENDAR

1950	
APRIL	
11–13	Southwestern Gas Measurement, Short Course, Norman, Okla., University of Oklahoma.
12–14	National Petroleum Association, Cleveland, Ohio, Hotel Cleveland.
24–25	Industrial Accident Prevention Association, Toronto, Canada, Royal York Hotel.
24–26	Natural Gasoline Association of America, Annual Convention, Fort Worth, Texas, Texas Hotel.
24–26	American Society of Mechanical Engineers, Process Industries, Pittsburgh, William Penn Hotel.
25–26	Metal Powder Association, Annual Show and Meeting, Detroit, Book-Cadillac Hotel.
26–28	American Institute of Electrical Engineers, Dist. 1, Providence, R. I., Sheraton Biltmore Hotel.
MAY	
1– 4	American Petroleum Institute, Division of Refining, Mid-Year Meeting, Cleveland, Ohio, Hotel Cleveland.
4– 6	Interstate Oil Compact Commission, Quarterly Meeting, Biloxi, Miss., Buena Vista Hotel.
7– 9	Independent Petroleum Association of America, Twenty-first Mid-Year Meeting, Los Angeles, Biltmore, Hotel.
8– 9	American Gas Association, Natural Gas Department Spring Meeting, Tulsa, The Mayo Hotel.
8–11	Liquefied Petroleum Gas Association, Annual Convention and Trade Show, Chicago, Palmer House.
15–17	Oil Industry Information Committee, Chicago.
15–18	National Fire Protection Association, Atlantic City, Chalfonte-Haddon Hall.
15–18	National Fire Protection Association, American Gas Association Exhibit, Atlantic City, N. J., Haddon Hall.
22–24	American Gas Association, Production and Chemical Conference, New York, Hotel New Yorker.
25–26	Natural Gas and Petroleum Assn. of Canada, Annual Convention, Windsor, Ont., Can., Prince Edward Hotel.
29–31	Texas College of Arts and Industries, Fifth Annual Short Course in Gas Technology, Kingsville, Texas.
JUNE	
4– 9	Society of Automotive Engineers, Summer Meeting, French Lick, Ind., French Lick Spring Hotel.
12–16	American Institute of Electrical Engineers, Summer and Pacific General Meeting, Pasadena, Calif., Huntington Hotel.
12–16	American Society of Mechanical Engineers, Oil and Gas Power Division, Baltimore, Md., Lord Baltimore Hotel.
12–16	American Society of Mechanical Engineers, 4th National Materials Handling and Exhibit, Chicago, International Amphitheater.
15–16	Pennsylvania Grade Crude Oil Association, Annual Meeting, Pittsburgh, Hotel William Penn.
18–20	Petroleum Equipment Suppliers Association, White Sulphur Springs, W. Va., The Greenbrier.
1950	
JUNE	
26–30	American Society for Testing Materials, 53rd Annual Meeting, 9th Exhibit of Testing Apparatus and Related Equipment, Atlantic City, N.J., Chalfonte-Haddon Hall
JULY	
3– 8	Institute of Petroleum Second Oil Shale and Cannel Coal Conference, Glasgow, Scot.
AUG.	
14–16	Society of Automotive Engineers, West Coast Meeting, Los Angeles, Biltmore Hotel.
SEPT.	
3– 8	American Chemical Society, Chicago.
5– 9	American Chemical Society, 6th National Chemical Exposition by Chicago Section, Chicago, Chicago Coliseum.
11–15	American Society of Mechanical Engineers, Industrial Instruments and Regulators Conference with the Instrument Society of America, Buffalo, N. Y., Municipal Auditorium.
13–15	National Petroleum Association, Atlantic City, N.J., Hotel Traymore.
18–22	Instrument Society of America, National Confernece and Exhibit, Buffalo, N.Y., Memorial Auditorium.
25–27	American Society of Mechanical Engineers, Petroleum Mechanical Engineering Division, New Orleans, The Roosevelt.
OCT.	
1– 3	Independent Petroleum Assn. o America, Annual Meeting, St. Louis, Mo.
2– 6	American Gas Association Annual Convention, Atlantic City, N.J.
15–20	Oil Progress Week.
16–20	National Safety Congress, National Safety Council Exposition, Chicago.
30 to Nov. 1	National Lubricating Grease Institute, Annual Meeting, Chicago, Edgewater Beach Hotel.
NOV.	
2– 3	Society of Automotive Engineers, Diesel Engine Meeting, Chicago, Hotel Knickerbocker.
9–10	Society of Automotive Engineers, Fuels and Lubricants Meeting, Tulsa, Okla., The Mayo.
11–13	Oil Industry Information Committee, Los Angeles, Biltmore Hotel.
13–16	American Petroleum Institute, 30th Annual Meeting, Los Angeles, Biltmore Hotel and Ambassador Hotel.
13–17	National Electrical Manufacturers Association, Atlantic City, N.J., Chalfonte-Haddon Hall.
26 to Dec. 1	American Society of Mechanical Engineers, New York, Hotel Statler.
DEC.	
3– 6	American Institute of Chemical Engineers, Annual Meeting, Columbus, Ohio.



Anaconda Arsenical Admiralty tube bundle ready for installation in one of the shells on top of superstructure.

Light Hydrocarbon from Fractionating Towers

Handled by ANACONDA ARSENICAL ADMIRALTY TUBES . . .

THE CONDENSERS shown in the photographs above are located at the butadiene plant of Sinclair Rubber, Inc., Houston, Texas. They were built to handle light hydrocarbon from the fractionating towers.

In order to provide the required heat transfer and economical service under the corrosive conditions encountered, the tubes being installed are Anaconda Arsenical Admiralty 439.

This Anaconda Alloy has been manufactured on a commercial basis since 1934. It is but one of 8 standard and several special condenser tube alloys currently produced by The American Brass Company.

This list provides tubes to meet a wide range of heat transfer requirements. The broad metallurgical knowledge and practical experience of our Technical Department is available in helping you make the right selection.

ANACONDA

Anaconda

CONDENSER TUBES

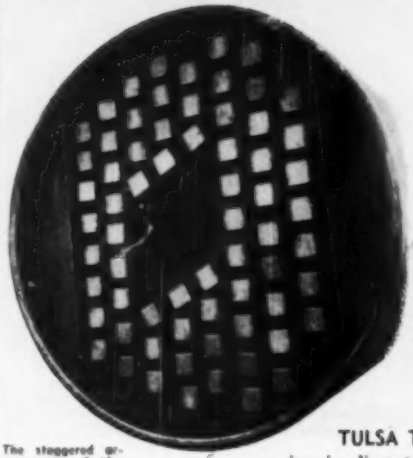
THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company

In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

TULSA TYPE



TULSA TYPE Bubble Towers are BUILT RIGHT to accomplish the processing function required.

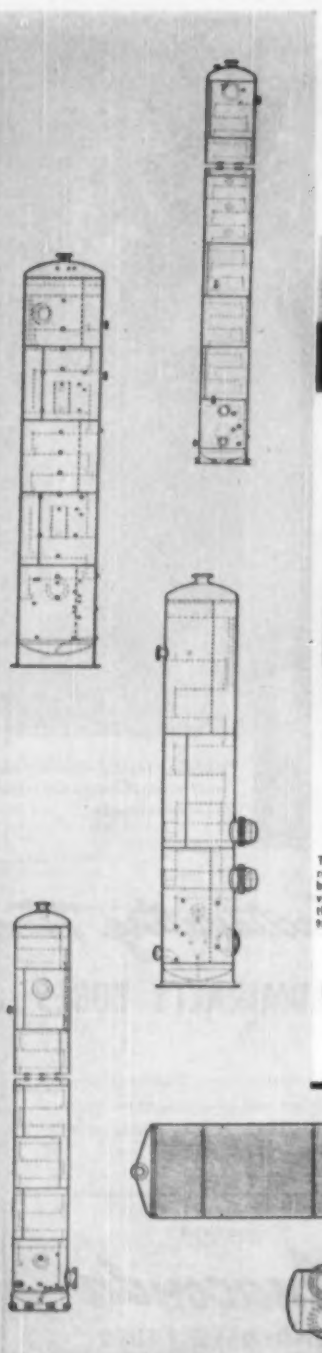
The staggered arrangement of the bubble caps prevents channeling of the liquid on the tray.

TULSA TYPE Bubble Towers, ranging in diameter from 12 inches to 13½ feet, are now giving successful performance in natural gasoline plants, oil refineries, butadiene plants and chemical processing plants.

WRITE FOR GENERAL CATALOG

FLINT STEEL CORPORATION

TULSA, OKLAHOMA



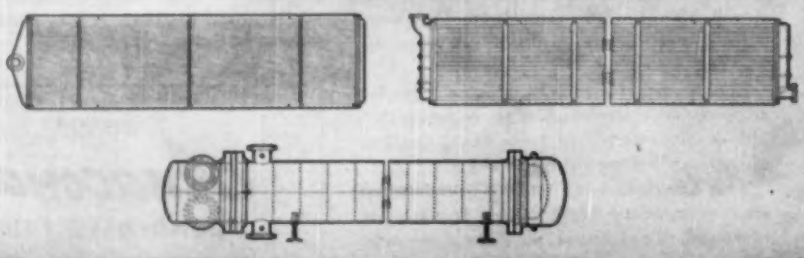


PLATE FABRICATING_____STRUCTURAL FABRICATING

REINFORCING FABRICATING_____WAREHOUSE PRODUCTS

Limited, a British subsidiary, was elected vice president, and George Macnoe president of Foster Wheeler Limited (Canada), was elected a director.

Natural Gas Specialists Schedule Tulsa May Meet

Reserves, rates and research will be discussed at the spring conference of the Natural Gas Department, American Gas Association at Tulsa May 8-9. Speakers include Roy Lund, mayor of Tulsa; D. A. Hulcy, president, Lone Star Gas Company, and director, natural gas department, AGA; Elmer F. Schmidt, vice president, Lone Star; Wesley E. Disney, counsel, The Independent Natural Gas Association of America; Hugh H. Cuthrell, vice president, Brooklyn Union Gas Company and president, AGA; N. C. McGowen, president, United Gas Pipe Line Company, and chairman of the reserves committee. Arthur F. Bridge, president, Southern Counties Gas Company; Guy T. Henry, president, Central Indiana Gas Company; Walter Herman, Commonwealth Services, Inc.; Oliver S. Hagerman, president and general manager, Virginia Gas Transmission Corporation.

Hiwan Oil Organizes Hiwan Petroleum Firm

The newly organized Hiwan Petroleum Company, affiliate of Hiwan Oil and Gas Company, will specialize in buying, selling and storing liquefied petroleum gas products. Pressure tankage for butane, propane and LPG mixtures of approximately two million gallons, with tank car and truck loading, unloading and blending facilities were involved in Hiwan Petroleum's estimated $400,000 purchase of the Cotton Valley, La., plant, constructed as an adjunct to the 100-octane refinery built by Reconstruction Finance Corporation. These new facilities will be combined with Hiwan Oil's existing natural gaso plant in the Atlanta field, near Magnolia, Ark.

Winner of Safety Award

The Okmulgee, Okla., refinery of Phillips Oil Company, as first place winner of 33 other units entered in Group C in the 1949 National Council petroleum section safety contest, holds an accident-free record for 1949. The employes worked more than 987,029 hours since July 1948 without a disabling injury.

Reprint Policy

A change has been made in PETROLEUM REFINER's policy with regard to small, individual orders for reprints of its articles. Since January 1 a charge of 50 cents per copy has been made WHEN REPRINTS ARE AVAILABLE. This will continue.

The charge for tear sheets of a particular article, effective April 1, has been reduced to 25 cents.

Cash or company requisitions should accompany all such "individual" orders.

This change does not affect the price for quantity orders of reprints (starting at 100 orders) which will be quoted upon request.

Continental Announces Refinery Promotions

Olehy

Vickery

Wall

Jones

J. H. Olehy has been transferred to Houston as regional manufacturing manager, southern region, Continental Oil Company, succeeding L. W. Vickery, appointed manager of the engineering department at the Ponca City, refinery. Others promoted are J. S. Hume to director of technical services, manufacturing department; H. R. Wall, to assistant superintendent, Ponca City refinery, in charge of lubricating and light oil divisions; J. M. Jones to superintendent, Lake Charles, La., refinery.

Hume

Olehy joined Continental in 1927 as assistant refinery engineer, Ponca City. He has since served as process engineer, chief process engineer, director of technical services, and manager of the engineering department.

Vickery has been with Continental as superintendent and regional refinery superintendent, southern region. He first began as refinery draftsman in 1929.

During Hume's 25 years with the company he has been resident chemist, and assistant superintendent of the Ponca City refinery.

Wall was with the Denver and Ponca City plants before becoming assistant superintendent and superintendent at Lake Charles.

Jones joined the Baltimore plant in 1926 as a chemist and has since become refinery superintendent.

Shell Oil Programs Multi-Million Research

An $18.5 million research program for 1950 is planned for Shell Oil Company's laboratories throughout the world with most of the budget earmarked for the company's four principal labs at Emeryville, Calif., Houston, Wood River, Ill., and Modesto, Calif. Others are at Union, N. J., Sewaren, N. J., and at five product control labs located at refineries throughout the U. S. Approximately 1.5 million will be spent a month on research directed principally toward the development of chemicals from petroleum.

The MONTH...

Pemex Completing New Salamanca Refinery

Several units of the new $12 million Salamanca refinery of Petroleos Mexicanos will be put in operation this month, according to Antonio J. Bermudez, director general of the government oil administration. The plant's completion will increase Mexico's petroleum refining capacity to about 190,000 barrels daily, according to Pemex. All units are scheduled for operation in May or June. Included are thermal cracking, atmospheric crude oil distillation, cat desulfurization, naphtha stabilization and miscellaneous treating; steam generating and power facilities; and a complete water system.

Designed for a capacity of 30,000 barrels a day, the refinery, located 180 miles northwest of Mexico City, will be supplied with crude oil by a recently finished 12-inch pipe line from the Poza Rica field, 280 miles distant. Subject to variations in demand and other factors, the refinery's daily output will be: motor gasolines, 11,600 barrels; fuel oils, 13,740 barrels; kerosine, 3210; diesel oils, 1000; and liquefied petroleum gas, 400.

Included in the 1950 construction program is a 5000-barrel-per-day refinery at Reynosa, Tamaulipas. Also planned are the erection of a lubricating oil plant, construction of a shipyard at Velacruz; replacement of certain tanker units natural gasoline plants in oil and gas fields; continued increase in storage capacity with replacement of storage tanks at refineries, terminals, fields and pumping stations.

Continuing Study Groups Are Appointed by IRAA

Studies of taxes at all levels in the industry plus phases of economics affecting the independent refinery will be made by two committees of the Independent Refiners Association of America. Fred C. Koch, president of Wood River Oil & Refining Company, was appointed head of the tax committee by the INRAA board, and D. W. Hovey, president of Danaho Refining Company, heads the economics group. Included in the economics study will be an analysis of the impact of recycling operation and methods that private and commercial publications use in publishing petroleum economics.

White House Thumbs Down On Synthetics Bills

The McCarran and Wolverton bills providing federal funds for initiating an experimental commercial-sized synthetic liquid fuels industry lie pending in Congress with the White House announcement last month to the Interior Depart-

ment and Capitol Hill that the present adequate domestic supply of petroleum makes the synthetics program one which can be postponed. Notice was given that President Truman desires no action this year on this legislation.

Names in the News

Wayne A. Howard has been appointed secretary of the manufacturing committee, Socony-Vacuum Oil Company, Inc., succeeding **W. H. Zabriskie,** retired. Zabriskie has been with the firm since 1914.

T. G. Hanlon becomes manager of the industrial relations department of Pan-Am Southern Corporation. Hanlon was with Pan American Refining Corporation, Texas City, from 1933 to 1943 when he transferred to Pan-Am Southern's Destrehan refinery as personnel supervisor. He has also served as head of personnel work for the marketing department and Destrehan refinery and as personnel and safety supervisor of the company.

Edwin J. Barth, petroleum technologist, has joined Gulf Oil Corporation, Pittsburgh, as a technical consultant in the general sales division.

Stanley W. Duhig, vice president and director of Shell Oil Company has retired. His service to the company and subsidiaries dates from 1913.

H. W. Haight, vice president and director in charge of Creole Petroleum Corporation's Venezuela operations, has been elected executive vice president of the company.

Cost Controller, Engineer For Thomas Bryan Firm

Appointment of J. M. (Mike) Fahey as cost control officer and Joseph E. Johnson, as project engineer has been announced by Thomas Bryan & Associates, Houston, building and engineering firm.

Fahey will represent the company's operations in five states. He is a graduate of Washington University, St. Louis, law school and was formerly with Harold Van Buskirk Company, Houston

Fahey

Johnson

contractors, James Stewart Corporation, and Stone & Webster Engineering Corporation, as personnel superintendent.

Johnson comes to the company from Birmingham, Ala., where he was estimator and project engineer for Rust Engineering Company.

Oil-Gas Reserves

The oil and gas industries had an exceptionally good year in 1949 in proving up reserves, it is revealed by analysis of the annual reports on U. S. reserves made public at the middle of March by the American Petroleum Institute and the American Gas Association.

New reserves proved in 1949 were twice the year's production for both natural gas and natural gas liquids and fairly close to twice the production for crude oil. Consequently, reserves of each of the three resources were at new all-time highs at the end of 1949.

The reserves proved up in 1949 were somewhat less than in 1948 for all three, crude oil, natural gas liquids, and natural gas—although oil well completions were nearly as numerous, while there were increases in condensate and gas well completions.

In proving new reserves of crude oil, 1949 was the third best year in history, exceeded by results in 1948 and 1937, which, significantly, also had more oil well completions.

Reserves of both natural gas and natural gas liquids have been and still are comparatively large in relation to existing markets. But during and since the war, markets have been sharply increased, and in spite of further net increases, in reserves, the reserves have been lowered somewhat in terms of years' supply at prevailing production rate.

Presented in tables herewith are the figures on reserves as reported by API and AGA. While the reports show end-of-1949 U. S. reserves of 28,378,501,000 barrels of liquid hydrocarbons (24,649,489,000 crude oil, 3,729,012,000 natural gas liquids) and 180,381,344,000 cubic feet of natural gas, they also show amounts of reserves proved up and amounts produced during the year, by states. Also shown are changes in U. S. reserves in each of several prior years.

Summary of Changes in 1949 in Proved U. S. Reserves of Crude Oil, Natural Gas Liquids, and Total Liquid Hydrocarbons (All Oils)

Sources: Crude oil from American Petroleum Institute; natural gas liquids and total liquid hydrocarbons from American Gas Association and API, jointly.

(Thousands of Barrels)

CRUDE OIL	
Total proved reserves as of Dec. 31, 1948	23,280,444
Revisions of previous estimates	+903,566
Extensions of old pools	1,093,862
New reserves discovered in 1949 in new fields and in new pools in old fields	890,417
Proved reserves added in 1949	2,187,845
Total proved reserves as of Dec. 31, 1948 plus new proved reserves added in 1949	26,468,289
*Less production during 1949	1,818,800
Total proved reserves as of Dec. 31, 1949	24,649,489
Increase in reserves during 1949	1,369,045
NATURAL GAS LIQUIDS	
Total proved reserves as of Dec. 31, 1948	3,540,782
Revisions of previous estimates and extensions of old pools	+294,211
New reserves discovered in 1949 in new fields and in new pools in old fields	92,565
Proved reserves added in 1949	386,776
Total proved reserves as of Dec. 31, 1948 plus new proved reserves added in 1949	3,927,559
*Less production during 1949	198,547
Total proved reserves as of Dec. 31, 1949	3,729,012
Increase in reserves during 1949	188,229
TOTAL LIQUID HYDROCARBONS	
Total proved reserves as of Dec. 31, 1948	26,821,227
Revisions of previous estimates and extensions of old pools	+2,591,630
New reserves discovered in 1949 in new fields and in new pools in old fields	982,982
Proved reserves added in 1949	3,574,621
Total proved reserves as of Dec. 31, 1948, plus new proved reserves added in 1949	30,395,848
*Less production during 1949	2,017,347
Total proved reserves as of Dec. 31, 1949	28,378,501
Increase in reserves during 1949	1,557,274

* 1949 production figures compiled by A.P.I. and A.G.A. reserves committees and where necessary based on 11 months actual production with an estimate for Dec. Any variance between actual production, as later reported, and figures used here will be compensated for through revision when following year's reserve report is compiled. These revisions have in past been very small.

Summary of Changes in 1949 in Proved U. S. Reserves of Natural Gas

Source: American Gas Association

(Millions of Cubic Feet)

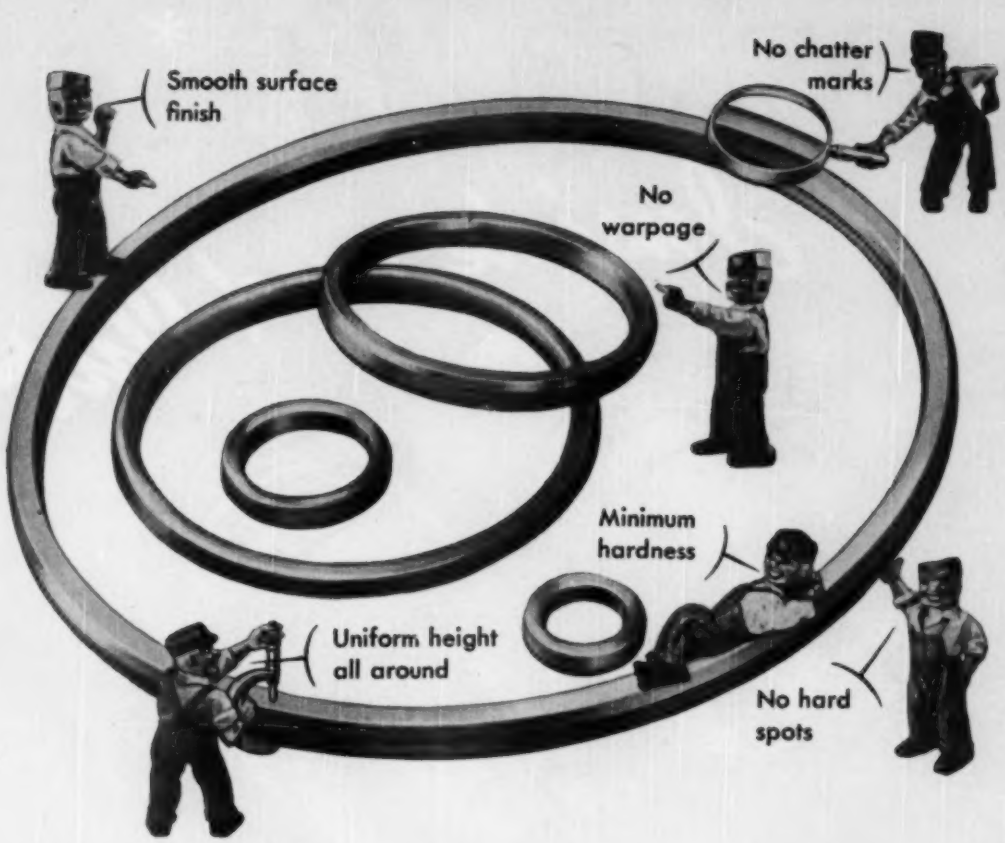
Total proved reserves as of Dec. 31, 1948	173,809,340
Extensions and revisions of previous est.	2,061,429
New reserves discovered in 1949	4,612,670
Net change in "stored gas" during 1949	82,746
Total proved reserves added and net changes in "stored gas" during 1949	12,757,045
Total proved reserves as of Dec. 31, 1948 and additions during 1949	186,826,385
Deduct production during 1949	6,345,041
Total proved reserves as of Dec. 31, 1949	180,381,344
Increase in natural gas reserves during 1949	6,512,004

Trends of Operations and Changes in Stocks

Figures on crude stocks are from Bureau of Mines weekly reports; all others from American Petroleum Institute weekly reports, which are estimates on Bureau of Mines basis.

(All figures in thousands of barrels—add 000)

Trends in Week Ended	Crude Oil: Production Daily	Crude Oil: Runs to Stills Daily	Crude Oil: Stocks Week End	Gasoline: Production Weekly	Gasoline: Stocks Week End	Gasoil and Distillate: Production Weekly	Gasoil and Distillate: Stocks Week End	Residual Fuel: Production Weekly	Residual Fuel: Stocks Week End
1949:									
January 29	5,493	5,490	255,480	17,531	114,677	7,547	62,142	8,178	63,333
February 26	5,401	5,412	261,965	17,631	114,383	7,420	54,008	8,225	60,348
March 26	5,159	5,353	260,506	17,417	126,087	6,167	48,721	8,008	56,792
April 30	4,980	5,273	271,285	17,060	124,767	6,081	49,680	8,185	60,174
May 28	4,951	5,297	275,190	16,334	120,061	5,943	55,971	8,144	63,788
June 25	4,944	5,332	274,114	16,462	118,715	5,148	63,040	7,836	66,146
July 30	4,751	5,187	271,990	18,038	108,964	6,393	70,767	7,205	67,186
August 27	4,799	5,315	266,453	18,180	100,280	6,491	74,718	7,597	66,394
September 24	4,933	5,377	259,159	18,142	103,363	6,555	81,414	7,419	63,143
October 29	5,075	5,360	253,069	18,072	103,918	7,016	90,358	7,754	60,489
November 26	5,192	5,331	256,409	18,204	104,917	6,971	91,795	8,104	57,087
December 24	4,955	5,483	256,920	18,045	110,104	7,335	78,993	8,049	61,647
1950:									
January 28	4,956	5,470	248,411	18,363	124,270	7,302	66,337	8,389	57,036
February 25	5,000	5,377	245,595	17,766	133,856	6,850	56,050	7,855	48,963
March 25	4,848	5,469	244,227	17,639	135,408	6,870	40,877	8,171	42,546



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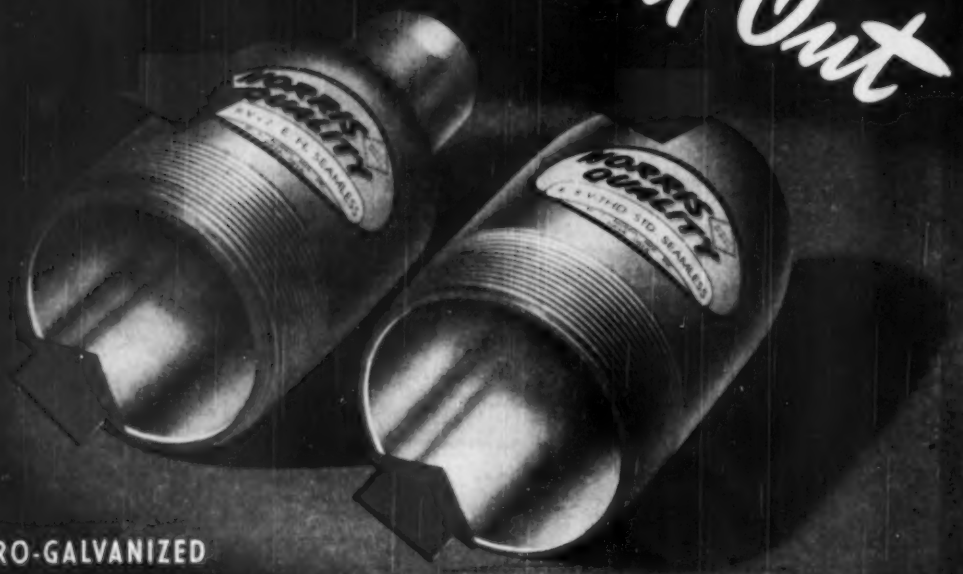

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SCIENCE and TECHNOLOGY Abstracts

Prepared by
DR. E. H. LESLIE and DR. H. B. COATS
The Leslie Laboratories
Traver Road, Ann Arbor, Mich.

Manufacture: Processes and Plant

Catalytic Dehydrogenation of Butenes. K. K. KEARBY. *Ind. Eng. Chem.*, **42** (1950), pp. 295-300.

The "Jersey" process of catalytic butene dehydration was adopted during the war for production of butadiene and made butadiene at one fourth the cost of butadiene produced from alcohol. Since the close of the war most of the butadiene produced in the United States and Canada has been made from butenes. The process was made feasible by the development of a satisfactory catalyst. The properties of the catalyst and of various alternate catalysts that were developed are described in the paper. Ultimate recycle yields of butadiene of 70 to 85 percent are obtainable at butene conversion levels of about 40 to 20 percent. The catalyst contains iron oxide with potassium carbonate as promoter. As originally used in the butadiene process it also contained oxides of magnesium and copper. Detailed data are presented in tabular form showing the results of butene dehydrogenation over catalysts of many different types. A bibliography of 20 references is included.

Butadiene from Ethyl Alcohol. Catalysis in the One- and Two-Step Processes. B. B. CORSON, H. E. JONES, C. E. WELLING, J. A. HINCKLEY, AND E. E. STAHLY. *Ind. Eng. Chem.*, **42** (1950), pp. 359-73.

An extended study of catalysts was made in the course of wartime research on the production of butadiene from ethyl alcohol. At the time interest was centered on the American two-step process, but studies were also made of the Russian one-step process, and the results of these studies are reported in the present paper. The best catalysts for the one-step process were oxide mixtures of silicon-magnesium-tantalum and silicon-magnesium-chromium, and the best yield obtained in the laboratory (at 400 to 425° C.) by the one-step process was 56 percent of the theoretical as compared to 64 percent by the two-step American process at the considerably lower temperature of 350° C. The same general areas in the periodic system were effective for both processes—mainly, the fourth and fifth groups, with less activity in the second and sixth groups. However, the specific catalysts for the two processes were not interchangeable. The American two-step process involved the dehydrogenation of ethyl alcohol to acetaldehyde, followed by the catalysis of ethyl alcohol-acetaldehyde to butadiene. Careful study of the second step reaction indicated the highest catalytic activity in combinations of silica with oxides of certain transitional elements of the fourth and fifth groups. In general, tantala-silica combinations showed highest activity at 350° C. Zirconia-silica and hafnia-silica combinations worked best at 300° C. The per pass yield of butadiene with the better catalysts was 30 to 35 percent and the ultimate yield 60 to 64 percent.

Evaluation of Equilibrium Stages and Transfer Units KUO TSUNG YU AND JAMES COULL. *Chem. Eng. Progress*, **46** (1950), pp. 89-94.

A simple correlation is presented for the calculation of the number of transfer units at finite reflux for systems with constant relative volatility in a packed fractionating column. A rapid graphical method is used in place of the tedious analytical solution. The maximum deviation is 6 percent. The new correlation gives results similar to two existing correlations developed for plate columns. The fundamental relationship between the number of transfer units and the number of equilibrium plates is derived and discussed. In the latter part of the paper a simple type of equation involving only two constants is presented to represent the vapor-liquid equilibrium relationship for many non-ideal systems. An equation is developed for the determination of the minimum number of equilibrium stages. This shows close agreement with the graphical solution. A new equation for determining the minimum number of transfer units is also given. A bibliography of 23 references is included.

The Application of Air-Foam to Oils Burning in Bulk. J. H. BURGOYNE, L. L. KATAN, AND J. F. RICHARDSON. *Jour. Inst. of Petroleum*, **35** (1949), pp. 795-817.

The first part of the paper is a report on the application of air-foam mixtures to burning oils. The mechanism of extinguishing depends on the burning characteristics of the oil and on whether the foam is applied from above the burning surface or by base injection. On light oils, such as gasoline, which burn with a surface temperature of not over 100° C., a blanket of foam can form at once and extinguishes the fire chiefly by interrupting the transfer of heat from the flames to the oil surface, thus preventing volatilization. With oils that form a high-temperature top-zone during burning, the hot-zone must be cooled before the flames subside. When the foam is applied by base injection, cooling of the hot zone is augmented by a stirring effect that mixes underlying cold oil with hot. If the application is slow, extinction occurs at a hot-zone temperature of 130° C., but if rapid, at lower temperatures. The extinction of fuel oil with top- and base-applied air-foam was studied with a 40-gallon charge. If foam is applied from above it must be applied at a minimum rate above that necessary to absorb the normal heat input from the flames to the hot zone. The extent to which frothing occurs is related directly to the amount of hot zone present, that is, to time of burning.

Oil from Oil Shale. Experience in the United States. R. A. CATTELL. *Jour. Inst. of Petroleum*, **35** (1949), pp. 841-7.

Studies indicate that 100 billion barrels of oil may be recovered from shale in the best 1000 square miles of the Green River formation in Colorado, and that much additional oil will be available from 15,500 square miles of that formation in Colorado, Utah, and Wyoming. A mechanized system of underground quarrying has been developed that will mine shale at a cost of 60 cents per ton. Continuing research is developing fundamental information concerning the characteristics of oil shale and shale oil. Tests with several types of retorts are being made at the demonstration plant near Rifle, Colo., and at several privately owned plants. The lower boiling products from shale-oil have a hydrocarbon composition similar to cracked petroleum products but also include substances that are characteristic of coal tars. Hydrogenation improves these distillates so that they can be refined by conventional means. It is estimated that shale oil can be produced with continuous retorts at a cost below $2 per barrel. It is recommended that

These abstracts from the current literature of science and technology (not including trade journals easily available) were prepared by Drs. Leslie and Coats of The Leslie Laboratories, Traver Road, Ann Arbor, Mich., which will supply, at cost, photostatic copies of original articles. Complete or limited bibliographies covering special topics by file, by abstracts, or in complete manuscript, also may be had by arrangement with the Laboratories.

Science and Technology

research and development work be continued so that shale oil may be available when it is needed.

The Use of Solid Carbon Dioxide to Extinguish the Burning of Liquids. J. H. Burgoyne, L. L. Katan, and J. F. Richardson. *Jour. Inst. of Petroleum*, **35** (1949), pp. 818-28.

Solid carbon dioxide is a material of more than ordinary interest for fire extinguishing, because it is capable of considerable heat absorption at low temperature, in the process of which it gives rise to a gas with flame suppressing properties. The mode of action of carbon dioxide depends upon its state of division. Powdered material, and in some cases small lumps, float on the burning liquid and cool the surface. Under these circumstances the effectiveness is increased as the liquid-surface temperature (or boiling point) and extinction temperature are greater, provided a hot zone is not formed. Larger sized grades of solid CO_2 sink in the inflammable liquid, and the evaporation of the material causes an effect similar to air-stirring. Liquids of high surface temperature and those that form a hot zone are more effectively treated by this method than by surface application of fine material, except that an edge-fire may be left which requires extinction by auxiliary means.

Some Practical Aspects of the Problem of Applying Foam to Large Tanks. E. Thornton. *Jour. Inst. of Petroleum*, **35** (1949), pp. 829-40.

During the early stages of a fire, foam in adequate quantities will extinguish the fires in tanks or reservoirs of gasolines or oil. In the case of large tanks, i.e., over 80 feet in diameter, technical difficulties arise in getting the foam onto the fire at an early stage and at an adequate rate. The author discusses these difficulties. Large tanks require extremely large amounts of foam and thus the problem of overhead application is complicated. Larger and lighter pipes and more limited points of entry seem worthy of consideration. Base injection is attractive on account of the lower foam quantity required and the greater certainty of entry. It is suggested that large scale tests will be necessary to place the whole matter on an adequate technical foundation and in any case to put the matter beyond the reach of futile arguments without adequate facts.

Chemical Composition and Reactions

Hydrocarbons. X. Three New Octenes. F. C. Whitmore, H. E. Whitmore, and N. C. Cook. *Jour. Am. Chem. Soc.*, **72** (1950), pp. 51-3.

Of the 66 possible structural isomers of the octenes, excluding *cis and trans* forms, 63 have been reported. The present paper reports the syntheses of the three remaining octenes: 5,5-dimthyl-2-hexene, 2,4-dimethyl-3-hexene and 3-ethyl-4-methyl-1-pentene. The *cis* and *trans* forms of the first two have also been separated. Three additional octenes, 5,5-dimethyl-1-hexene, 2,4-dimethyl-2-hexene, and 3-ethyl-4-methyl-2-pentene were also made in the course of the other preparations. Physical properties of all the highly purified substances are reported. Dehydration of 2,4-dimethyl-3-hexanol was studied as a typical example of a secondary alcohol with single branching on both α-carbons. It was found that rearrangements of the order of 25 percent occurred, most of which resulted in changes of the carbon skeleton.

Solutions of Aluminum Chloride as Vigorous Catalysts. Alfred W. Francis. *Ind. Eng. Chem.*, **42** (1950), pp. 342-4.

Aluminum chloride has been used as a catalyst under many different conditions to accomplish many reactions. When used as a solid, an induction period of 20 minutes to several hours is frequently required. To diminish side reactions the reagent has been diluted with other substances. This procedure is satisfactory for mild catalysis. When vigorous catalysis is required, such as for the ethylation of isobutane, or the isomerization of normal paraffins, especially butane, it has been found inadequate. The author reports that the alkylation of isoparaffins with ethylene and the isomerization of normal paraffins including butane can be catalyzed with solutions of aluminum chloride in organic solvents containing a molar excess of aluminum chloride. These catalysts are even more vigorous than solid aluminum chloride because the induction period is avoided. Solvents such as acetone, sulfur dioxide, ethyl acetate and ethyl ether were used. A bibliography of 19 references is given.

Fundamental Physical and Chemical Data

Heats, Equilibrium Constants and Free Energies of Formation of the Dimethylcyclopentanes. Morton B. Epstein, Gordon M. Barrow, Kenneth S. Pitzer, and Frederick D. Rossini. *J. Research Natl. Bur. Standards*, **43** (1949), pp. 245-50 (Research Paper No. 2026).

By adding the necessary increments to the corresponding functions of methylcyclopentane, the following thermodynamic properties were calculated to a temperature of 1500°K.: heat-content function, free-energy function, entropy, heat content, heat capacity, heat of formation from the elements, free energy formation from the elements, and the logarithm of the equilibrium constant of formation from the elements. Equilibrium constants and concentrations are given for several isomerization reactions.

The Viscosity and Heat Conductivity of Steam. Frederick G. Keyes. *Jour. Am. Chem. Soc.*, **72** (1950), pp. 433-6.

A series of measurements of the thermal conductivity of steam up to 350°C. and 150 atm. pressure were made, using a concentric cylinder apparatus designed for measurements under pressure. The new values are lower than older data obtained through the use of the hot wire method to the extent of differences up to 38 percent at 150 atm. A correlation of the viscosity values of steam as given by previous investigators was made. The values of Solberg and Potter are believed to be the most reliable. The value of the ratio, thermal conductivity, divided by specific heat times viscosity is 1.2 and is independent of the temperature between 100 and 600° C. As pressure increases, the value of the ratio decreases.

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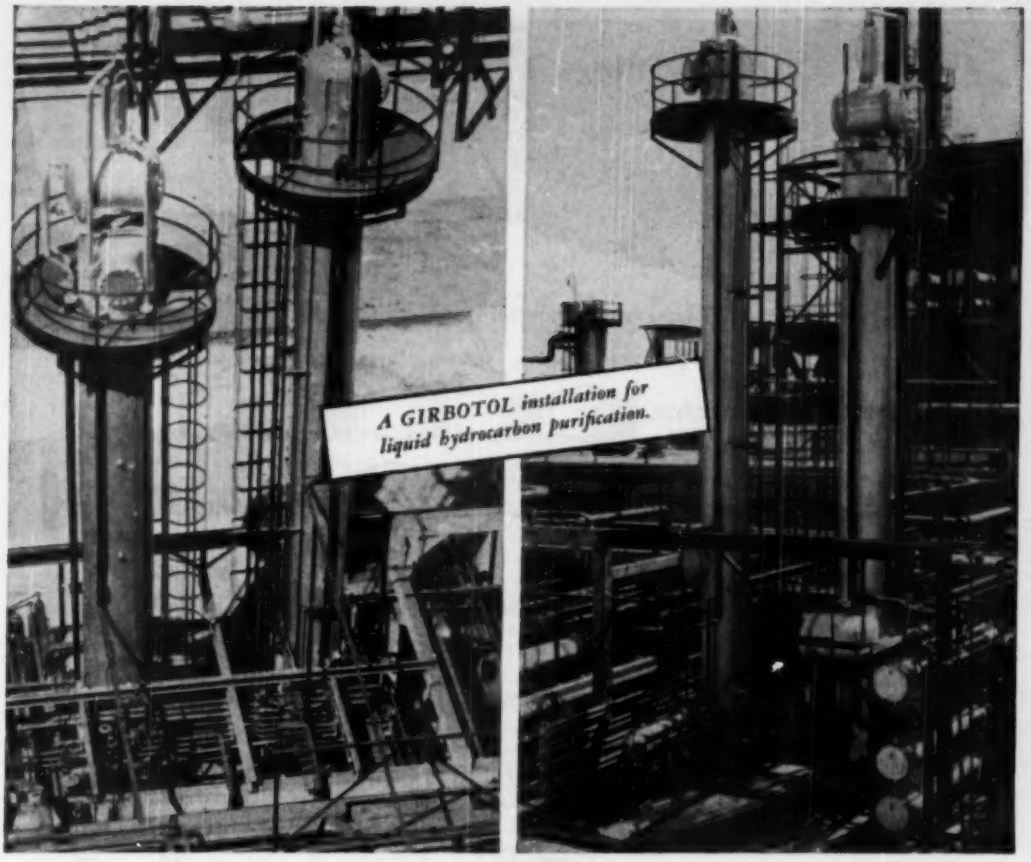
4-Heptanethiol
2-Ethylbenzenethiol
3,4-Dimethylbenzenethiol
1-Thiabutylbenzene
1-Thiahexylbenzene
Cyclohexanethiol
4-Thia-1-heptene
2-Thiadecane
Thiacycloheptane
Laurone
Carbon monosulfide
1,8-Dichlorooctane
Isobutyl peroxide
n-Dodecafluoropentane

Heats of Adsorption and Molecular Configuration. The Pentanes on Carbon Black. R. A. Beebe, G. L. Kington, M. H. Polley and W. R. Smith. *Jour. Am. Chem. Soc.*, **72** (1950), pp. 40-2.

The isotherms and calorimetric heats of adsorption were determined at 0° for n-butane, n-pentane, neopentane and cyclopentane on a sample of carbon black that was extensively used in previous adsorption studies. When the coverage is 0.05 percent of the surface, the contribution of a $-CH_3$ group of the normal hydrocarbons is approximately 3 kcal. per mole. However, for neopentane and cyclopentane the contribution per $-CH_3$ or $-CH_3$ group is less than 3 kcal. As an explanation it is suggested that the differences in the energies of binding of these pentanes to the surface, as indicated by the thermal measurements, may be attributed to differences in the geometric fit of the molecules to the carbon black surface.

Diffusional Properties of Multicomponent Gases. C. R. Wilke. *Chem. Eng. Progress*, **46** (1950), pp. 95-104.

The purpose of the authors was to develop an approximate method for calculation of steady-state diffusion in complex gas mixtures, which method should be sufficiently accurate for most purposes and yet which avoids the mathematical difficulty of a rigorous treatment. An expression is derived for the effective diffusion coefficient of a gas with respect to a multicomponent mixture of stagnant gases. The application of this relationship is studied by comparison with the exact solutions of the diffusion equations for various types of diffusion. Experimental data are given. The application to the calculation of vis-



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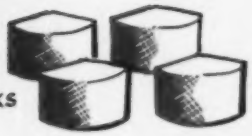
If you have several cone roof tanks 

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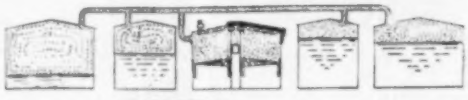
tanks were hooked up  with a

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cosities of gas mixtures is presented. Approximate methods of calculation of rates of diffusion in complex mixtures for stagnant films, and also with simultaneous diffusion of all components are presented. The effects of simultaneous diffusion on mass-transfer coefficients are discussed. A bibliography of 33 references is included.

The Dipole Moments and Structures of Some Alkali Disulfides and of Methyl Trisulfide. LAWRENCE M. KUSHNER, GEORGE GOBIN AND CHARLES P. SMYTH. *Jour. Am. Chem. Soc.*, **72** (1950), pp. 477-9.

The dipole moments of methyl, ethyl and propyl disulfides, and of methyl trisulfide were measured at 30° C. and found to be 1.95, 1.96, 1.96, and 1.66×10^{-18} respectively. The value as determined for the trisulfide compound is consistent with an unbranched chain structure for that particular molecule.

The Angle of Contact Between Water and Wax. G. D. YARNOLD AND B. J. MASON. *Proc. Phys. Soc.*, (London) **62B** (1949), pp. 125-8.

The effects of the velocity of the liquid surface, and the time of immersion on the angle of contact between clean surfaces of water and wax were studied by a dynamic method. Experiments with water and a paraffin-wax coated steel sphere are described. It was found that a definite value can be assigned to the angle of contact of a liquid only if the exact conditions of observation are specified. Not only the state of the surfaces but also their relative velocities and the time during which they have been in contact must be stated. There is no single angle of contact corresponding to rest conditions, and the authors conclude that the term "equilibrium angle of contact" is practically meaningless.

Products: Properties, Utilization and Analysis

Commercial Vehicle Octane Requirements. J. A. EIGER, R. L. GREENSHIELDS, H. J. GIBSON, AND G. W. PUSACK. *SAE Journal*, **57** (1949), pp. 24-8.

Fuel needs of commercial vehicles and passenger cars were found to be similar, on the basis of maximum requirement for knock-free performance. Three sets of conditions were studied: 1) maximum antiknock requirements at 750 rpm. or above; 2) maximum antiknock requirement in the normal working range; and 3) antiknock requirement at engine speed 2250 rpm. Over most of the range the difference between passenger cars and commercial vehicles was only about two octane units. In some cases benefits were obtained by distributor adjustments, but the general level of requirements was not changed greatly by ignition system adjustments.

Determination of Liquir-Vapor Equilibria. New Dew Point-Bubble Point Apparatus. MORRIS FELLER AND HUGH I. MCDONALD. *Analytical Chem.*, **22** (1950), pp. 338-40.

The determination of bubble point and dew point has been used for many years to study the phase behavior of hydrocarbons in petroleum. In most cases, this work has been concerned with substances of low molecular weight, such as methane, ethane, etc., which are ordinarily gases or liquids of low boiling point. The authors were concerned with an apparatus for determining the liquid-vapor equilibria of binary systems that are liquid at room temperature and atmospheric pressure, and in using a dew-point-bubble-point apparatus for the purpose. In place of determining liquid and vapor compositions, the positions of the liquid and vapor curves on the equilibrium diagram are determined by measuring the bubble point and dew point at any given composition. The method is advantageous because only small amounts of materials are needed for the complete determination of the diagram for the system. No analyses are required. Typical results are compared to those obtained by measuring liquid and vapor compositions. The apparatus can also be applied in determining the molecular weight of liquids, analysis of binary liquid systems, and in the study of liquid-vapor equilibria of tenary and more complex systems.

Determination of Bromine and Chlorine in Gasoline. BENJAMIN PECHERER, C. M. GAMBRILL, AND G. W. WILCOX. *Analytical Chem.*, **22** (1950), pp. 311-15.

Although there are several methods available for the determination of halogen in organic compounds, there has been no satisfactory procedure for the analysis of dilute solutions of halogen compounds in organic solvents, especially if the halogen compound is relatively volatile or difficult to decompose. The determination of the ethylene halides present in gasolines, where the total amount of halogen is less than 0.01 equivalent per liter is an example. The authors present a method, stated to be accurate within ±2 percent, that involves the use of disodium biphenly for decomposing the ethylene halides. The gasoline to be analyzed is diluted with benzene and treated with an excess of 0.5 *N* solution of disodium binhenyl. After approximately 30 minutes, the excess reagent is decomposed with water, the alkali formed is neutralized, and the sodium halides extracted from the organic phase with water. The halides are determined by potentiometric titration using a silver-silver chloride electrode system. Tetraethyllead does not interfere. The method can be used for the determination of carbon-bonded bromine and chlorine in the organic compounds other than the ethylene halides.

Acid-Base Determinations of Petroleum Products. H. P. FERGUSON. *Analytical Chem.*, **22** (1950), pp. 289-94.

Cooperative tests during the past several years have indicated that no satisfactory method of determining the acidic or basic components in petroleum products by two-phase titration is available. Because of poor reproductibility of the two-phase methods, Committee D-2 of the ASTM has conducted an extensive cooperative program with a view to improving the methods for determining acids and bases. This work is summarized in the paper. The conclusion was reached that none of the two-phase equilibrium procedures could be controlled to give reproducible results. An excellent single-phase electrometric method has been developed and standardized. Color indicators were also used to determine end points. One of these was selected for ASTM standardization, inasmuch as the results were in good agreement with those obtained by electrometric titration. The data are presented in detail in tabular form.

Science and Technology

Petroleum. HARRY LEVIN. *Analytical Chem.*, **22** (1950), pp. 240-4.

The article is part of the second annual review of Analytical Chemistry and covers the field of petroleum, including crude oil, gas, gasoline, kerosine and heavier fuels, lubricating oils, specialties, determinations of elements in petroleum products, atmospheric pollution, sulfur in petroleum products, catalysts, and miscellaneous related subjects. A bibliography of 140 references is included, published in 1948 and 1949.

Laboratory Flow Tests of Fixed Spray Nozzles with Hydrocarbons and with Air. M. R. SHAFER AND H. L. BOVEY. *J. Research Natl. Bur. Standards*, **43** (1949), pp. 449-57.

The authors investigated spray nozzles of the type used in some turbo-jet engines. Three sets of 60 nozzles were flow-tested as received at five different pressures. Significant changes in flow characteristics were observed before and after being tested at 250 pounds pressure. Some of the nozzles contained burrs or metal chips and were improperly machined, all of which caused erratic fluid metering. After reconditioning, a group of 26 nozzles were tested with five different fluids. The results indicate that it is not practical to correct for differences in the physical properties of the test fluid. A comparative method of flow-testing the nozzles with air is described. Although this leaves much to be desired, it does provide a safe and rapid sizing of the nozzles to within ±3 percent of the actual flow.

Foreign Crude Oil Analyses

Results of crude oil analyses from fields in the Middle East, South America, and Canada are given in the Bureau of Mines Report of Investigations 4657 which shows foreign production of crude petroleum has jumped to a total of more than one billion barrels a year in these areas. At Bartlesville, Okla., Bureau petroleum chemists analyzed 35 crude oil samples from fields in Iran, Iraq, Saudi Arabia, Colombia, Peru, Venezuela, and Canada. The publication includes a table showing fields by country, year of discovery, and production for 1948. Other tables give a breakdown of the general characteristics of the oil samples, including the percentage of gasoline and naphtha in samples, and a list of, as well as a bibliography, for all analyses of foreign crude oils published by the bureau. **Analyses of Some Crude Oils from the Middle East, South America, and Canada**, was prepared by O. C. Blade and E. L. Garton, bureau petroleum chemists, and C. M. McKinney, bureau chemical engineer.

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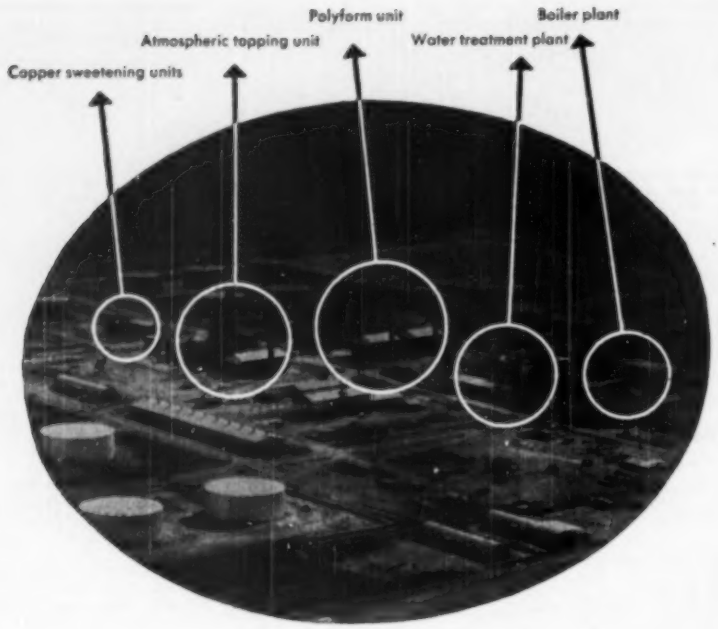

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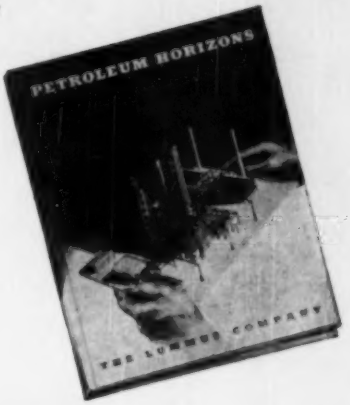

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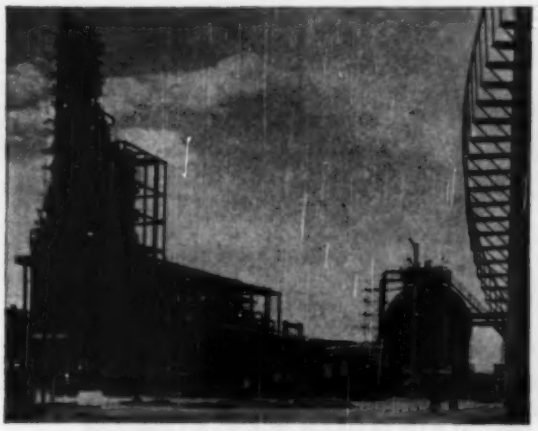

Atmospheric topping unit, with 34-foot settling sphere of desalting unit at right. The gas recovery system consists of a compression recontacting operation followed by depropanization. The topping unit is equipped with a single down-draft Lummus furnace.

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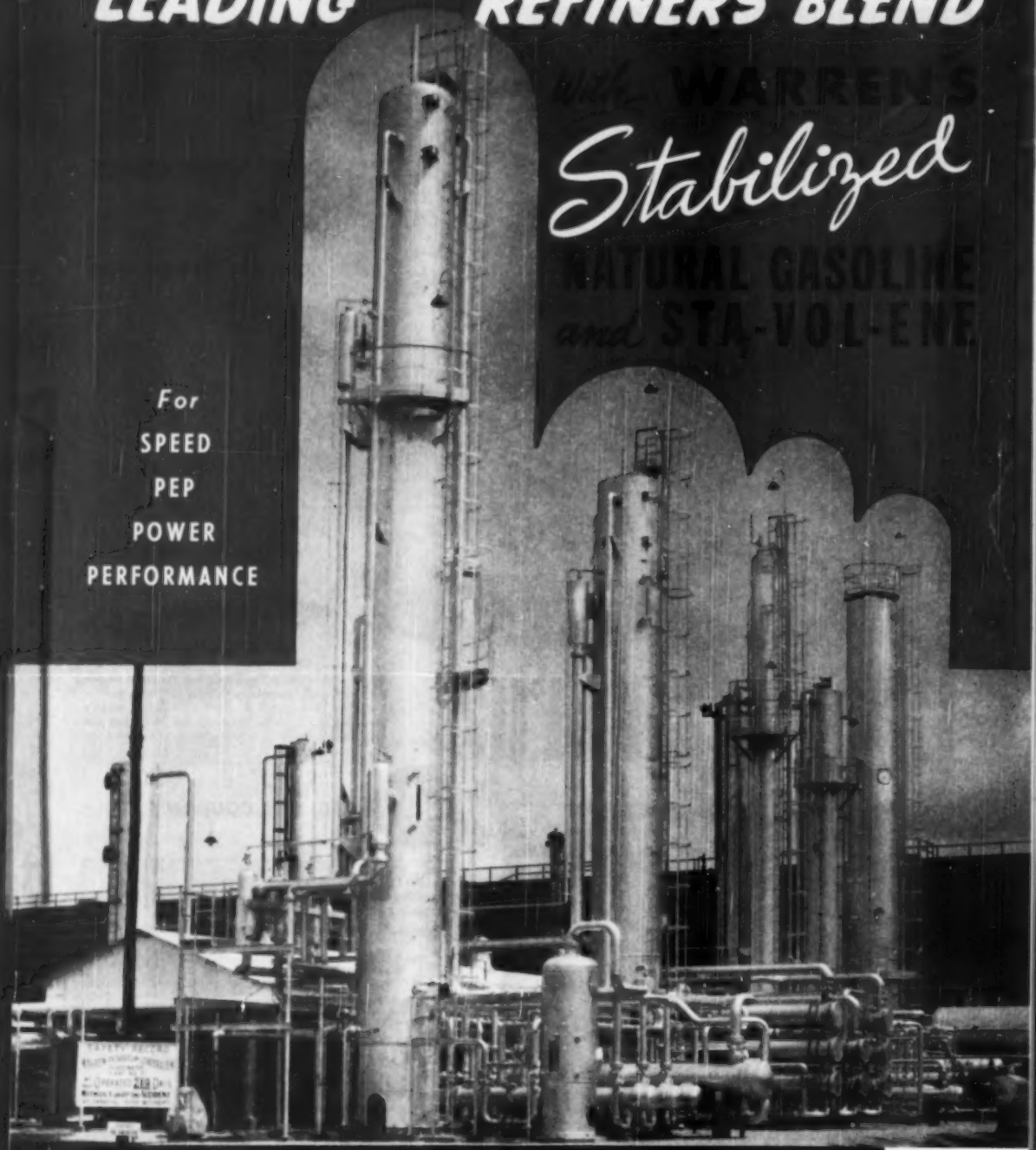

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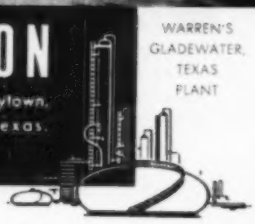

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Digest of Recent U. S. PATENTS Pertaining to PETROLEUM REFINING

Compiled by HEINZ HEINEMANN

(From the Official Gazette, January 10, 17, 24, 31 and February 7, 1950)

ALKYLATION

U.S.P. 2,495,323. Alkylation Process. A. Gislon to Compagnie Francaise de Raffinage (Socite Anonyme).

In the alkylation of monocyclic aromatic hydrocarbons, an olefin and HCl gas are fed to a first reaction zone containing a metal chloride catalyst. By partial conversion of the olefin, a mixture containing substantial amounts of both the olefin and the corresponding alkyl chloride and of HCl gas is obtained. This mixture is contacted in a second zone with a monocyclic aromatic hydrocarbon in the presence of a Friedel-Crafts catalyst to cause this hydrocarbon to be alkylated by the alkyl chloride and at least a portion of the olefin.

CRACKING AND REFORMING

U.S.P. 2,493,761. Cracking Catalyst and Cracking Process Utilizing the Same. E. C. Hughes and S. M. Darling to The Standard Oil Company (Ohio).

Higher boiling hydrocarbons are cracked in the presence of a silica-free catalyst comprising alumina and 1/20 percent of beryllium fluoride. The catalyst shows a high activity and a high conversion index with low coke formation.

U.S.P. 2,494,586. Cracking Hydrocarbons with Modified Koalin Catalyst. H. A. Shabaker to Houdry Process Corporation.

In the cracking of petroleum oil a modified clay composite catalyst of low iron content is employed which is prepared by first treating an iron-and-aluminum-containing koalin clay with acid. The iron-containing extract is discarded, and the koalin is further treated with acid to dissolve a substantial portion of the aluminum present. The aluminum salt solution formed is reacted with an alkali metal silicate in the presence of the koalin residue to precipitate an insoluble aluminum compound in the koalin residue.

U.S.P. 2,495,613. Method of an Apparatus for Cracking Tarry Materials. M. H. Tuttle.

The upper portion of a bed of loose pieces of refractory material is heated in a non-oxidizing atmosphere to cracking temperature by radiant heat supplied from above. Liquid hydrocarbons are fed to the top of the bed while reacted hydrocarbon vapors are withdrawn from the cooler bottom of the bed.

U.S.P. 2,495,723. Liquid Phase Cracking of Hydrocarbons with Water-Saturated Catalysts. H. A. Hormann to Houdry Process Corporation.

A hydrocarbon fraction heavier than gasoline is contacted in the liquid phase with a bed of solid, particulate, adsorptive, active cracking catalyst under mild cracking conditions and a catalyst temperature of 200-700°F. The catalyst is previously saturated with water vapor by steam treatment to the capacity possible under the initial hydrocarbon-catalyst contacting conditions. Lower boiling distillate type hydrocarbons are obtained. Concomitant conversion of the feed to substantial amounts of normally gaseous hydrocarbons and coke-like products is inhibited.

U.S.P. 2,495,751. Conversion of Hydrocarbons with Modified Clay Catalysts. G. A. Mills and E. B. Cornelius to Houdry Process Corporation.

Higher boiling hydrocarbons are cracked in the presence of a catalyst prepared by extracting clay with acid to dissolve a substantial amount of its aluminum content. The undissolved clay residue is purified by removing iron compounds therefrom and is then composited with gel formed by precipitation of the dissolved aluminum salts with an alkali meatl silicate in the presence of the undissolved clay residue. The resulting composite is freed of water-soluble salts and calcined.

U.S.P. 2,496,356. Catalytic Apparatus. N. P. Peet to Standard Oil Development Company.

A catalytic apparatus is claimed which is particularly useful in catalytic cracking operations using a finely divided catalyst held in suspension in the reaction material.

CATAYLST PREPARATION, ACTIVATION, AND REGENERATION

U.S.P. 2,493,784. Catalyst Regeneration Apparatus. L. F. Strader to Houdry Process Corporation.

Details are claimed of a regenerating kiln for regenerating spent catalyst, the vertical shaft of this kiln being provided in its lower portion with a series of horizontal partitioning plates. The uppermost plate has a plurality of uniformly distributed apertures, and successive plates have progressively decreasing numbers of such apertures horizontally staggered with respect to those in the next higher plate.

U.S.P. 2,493,896. Preparation of Silica-Alumina Catalyst. W. A. Pardee and G. E. Elliott Jr. to Gulf Research & Development Company.

An organic compound capable of yielding silica when subjected to heat and the catalytic influence of activated alumina, e.g. an alkyl silicate, is deposited on active alumina in amount sufficient to yield a silica-alumina catalyst containing 1-50 percent silica. The resulting mixture is heated, e.g. to 100-500°F., to catalytically decompose the deposited compound into silica without causing distillation. The product is calcined.

U.S.P. 2,494,587. Forming Gaseous Sulfides and Sulfidation Therewith. H. A. Shabaker to Houdry Process Corporation.

An iron-containing clay is contacted with a diluting sulfiding gas at a temperature of at least 1200°F. and below that at which sintering of the clay occurs. The iron sulfide formed is leached with dilute acid. A catalytically active conversion catalyst of low iron content is obtained. The dilute sulfiding gas employed is composed of minor amounts of H_2S and CS_2 carried in an inert gas, and is produced by reacting with elemental sulfur and in the presence of clay, H_2, and CO contained in a heated gaseous mixture predominating in inert gas.

U.S.P. 2,494,614. Process and Apparatus for Fluidized Catalyst Regeneration. H. W. Grote to Universal Oil Products Company.

Fluidized beds of contaminated catalyst are maintained in a regenerating zone in a series of superimposed contacting zones. The flow between this series of zones is restricted and successively lower pressures are maintained from the lowermost to the uppermost zone. A portion of the gaseous regenerating medium is supplied to the lowermost zone whereby the catalyst particles

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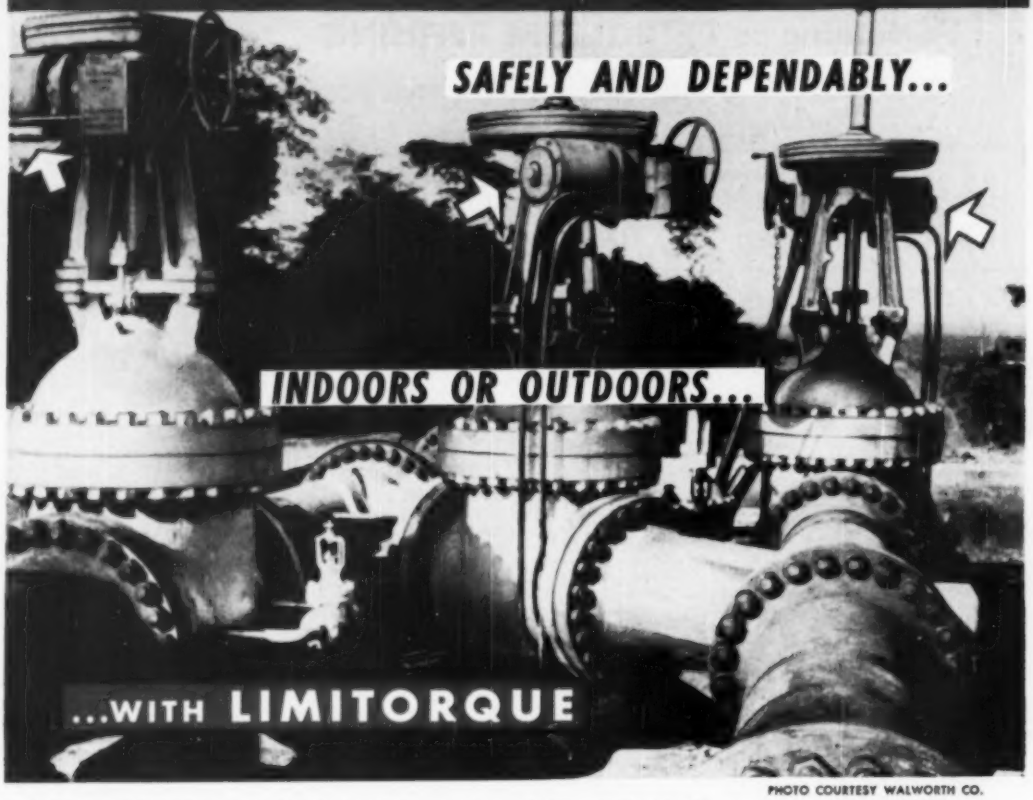

PHOTO COURTESY WALWORTH CO.

The above illustration was taken in far-off Venezuela, and shows 3 Electrically Operated *LimiTorque Valve Controls* mounted on 24" cast steel *Walworth* (series 300) *Valves*.

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are reactivated and transferred in fluidized condition upwardly through each of the zones. The catalyst particles accumulated in an upper zone are passed in a relatively compact column down to the lowermost zone by means of a second, downwardly directed portion of the regenerating medium.

U.S.P. 2,494,794. Process of Hydrocarbon Treatment and Regeneration. W. S. Bonnell to Gulf Oil Corporation.

In order to prevent overheating of cracking catalyst pellets during regeneration in a vertical regenerator through which they pass downwardly by gravity while in contact with oxygen-containing gas at elevated temperature, previously regenerated catalyst pellets are introduced into the regenerator against the top of a wall thereof which becomes overheated during regeneration. The regenerated pellets flow downward along this wall and, due to the lack of combustible material thereon, cause a reduction in the temperature of this wall.

U.S.P. 2,494,867. Removal of Flourine from Organic Materials. F. E. Frey to Phillips Petroleum Company.

In the catalytic conversion of hydrocarbons in the presence of a HF catalyst, at least a portion of the used liquid HF, which contains dissolved flourine-containing organic impurities, is separated from the conversion effluents. This portion is fractionally distilled to separate purified HF from the impurities. The residual liquid impurities are heated in order to decompose them and to form HF therefrom.

U.S.P. 2,495,497. Method of Liquid Stabilization of Nickel Catalysts. J. F. Ahlberg and C. F. Hiskey to the U. S. Atomic Energy Commission.

Reduced nickel catalysts to be used for hydrogenation purposes are stabilized against oxidation by condensing steam to form a water film on the surface of the catalyst and evaporating the film with air.

U.S.P. 2,495,700. Silica-Alumina-Nickel Dehydrogenation Catalyst. B. B. Corson and G. A. Webb to Koppers Company, Inc.

A dehydrogenation catalyst consists of a major portion of alumina and a minor portion of silica activated with 1/3 percent of an oxide mixture of Ni or metallic Ni.

U.S.P. 2,495,786. Prevention of After-Burning in a Moving Bed Catalyst Regeneration Process. L. F. Strader to Houdry Process Corporation.

Details are claimed of a process for the regeneration of a granular cracking catalyst, comprising a plurality of inorganic refractory oxides, moving downwardly through a plurality of superimposed combustion zones to which separate and independently controlled streams of air are admitted, a predetermined fraction of the total coke being burned off in each of the zones at temperatures below 1200°F. The amount of

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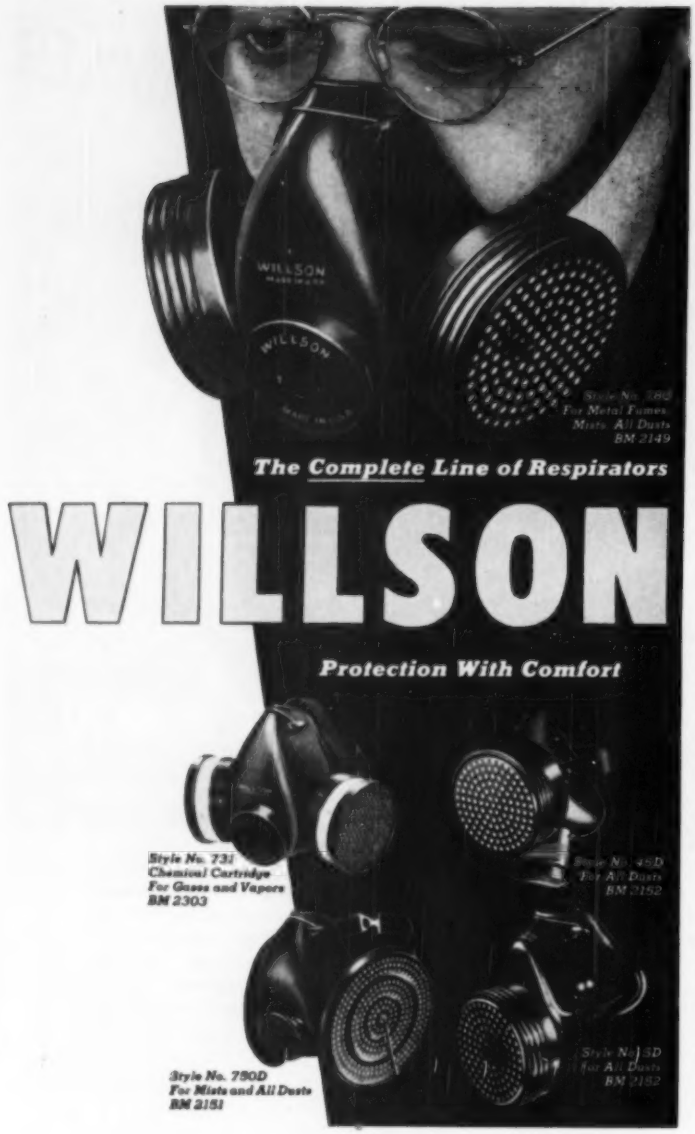

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Patents

air admitted to each zone shall be substantially in excess of that required for the partial burning of the coke in any zone, and steam is added to the early intermediate zones at controlled rates.

U.S.P. 2,496,396. Manufacture of Inorganic Oxide Spherical Particles. L. S. Kassel to Universal Oil Products Company.

Droplets of an inorganic oxide sol capable of setting to a hydrogel, e.g. a mixture of water-glass and acid, are passed into a water-immiscible suspending liquid in a forming zone. Agglomeration of hydrogel on the internal surfaces of this zone is prevented by interposing between these surfaces and the suspending liquid a solid ethylene polymer insoluble in this liquid.

U.S.P. 2,497,053. Measuring and Controlling Apparatus for Catalyst Regenerators. W. P. Wills to Minneapolis-Honeywell Regulator Company.

Details are claimed of a system for controlling the regeneration of catalysts contaminated by carbonaceous material. It allows the control of the periodic regeneration of catalysts used in a process in which the control temperature may vary rapidly through a wide range. A multiplicity of thermocouples individually responsive to the temperatures at different points in the regeneration chamber is combined so as to form elements responsive to the general or average magnitude of the temperatures at the different points and to the average rate of variation of these temperatures.

REFINING

U.S.P. 2,493,911. Separation by Adsorption. P. L. Brandt to Pan American Refining Corporation.

Details are claimed of a process for the separation of components of a gasiform stream, particularly in the separation of hydrocarbons of different mol weight, such as butanes and propanes from methane, or the recovery of gasoline from natural gas, or in the separation of hydrocarbons of similar mol. wt. but different chemical constitution, such as butanes from butenes. Adsorbent solids of small particle size are cycled from an adsorption zone to a desorption zone and back to the adsorption zone. The adsorbent is transferred from a low level to a high level by the gas lift effect of liberated product gases or vapors without the use of extraneous carrier gases and without provision of a gas compressor for supplying carrier gas.

U.S.P. 2,493,981. Treatment of Hydrocarbons. J. W. Latchum Jr. to Phillips Petroleum Company.

Easily condensible hydrocarbons are extracted from a distillate well effluent. The extracted effluent is desiccated by passage through a bed of solid desiccant material. Difficultly condensible hydrocarbons are then cooled and extracted from the dried effluent.

U.S.P. 2,494,274. Extractive Distillation

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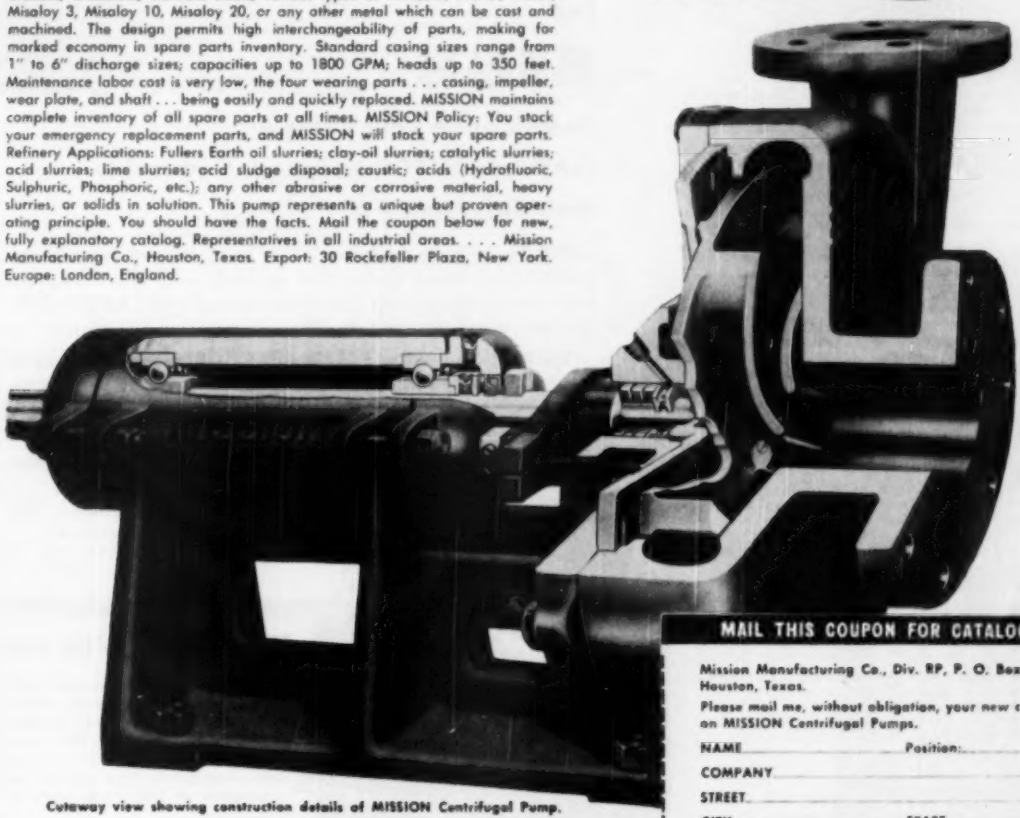

Cutaway view showing construction details of MISSION Centrifugal Pump.

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Process. R. C. Woerner to Sinclair Refining Company.

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U.S.P. 2,494,335. Method for Producing High Purity Normal Heptane. K. J. F. Dutson to Standard Oil Development Company.

A naphtha containing normal heptane in admixture with hydrocarbons of similar boiling point including methylcyclohexane is contacted in the presence of hydrogen with a dehydrogenation catalyst for naphthenes at a temperature of 900-950° F. and at a pressure of 180-250 psi. A fraction boiling between 200-215° F. is separated from the resulting product of this first stage and re-treated under equal conditions. The resulting product of this second stage is refractionated and the fraction thereof boiling between 205-215° F. is treated with H_2SO_4. On re-distillation a fraction boiling between 208-211° F. is obtained which consists of substantially pure normal heptane.

U.S.P. 2,494,371. Method for Removing Oxygenated Organic Compounds from Hydrocarbons. E. F. Wadley to Standard Oil Development Company.

Hydrocarbons contaminated with organic acids, esters, ketones, alcohols, and aldehydes are mixed with a solution of an alkali metal hydroxide in anhydrous methyl alcohol at a temperature of 150-600° F. for a period of time between 0.5-12 hours. Substantially complete saponification of the contaminants is obtained. On settling, a hydrocarbon phase is separated from the resulting mixture. Contaminant-free hydrocarbons are recovered from this phase by contact with an alcoholic solvent.

U.S.P. 2,494,392. Process and Apparatus for Treating Emulsions. C. G. Kirkbride and T. A. Burtis to Texas A. and M. Research Foundation.

Aqueous matter is removed from oil emulsions, such as salt water from petroleum emulsions containing the aqueous matter as the dispersed phase, by progressively coalescing the dispersed phase by passing the entire emulsion downwardly through a zone consisting of a series of separate beds of closely packed glass fibers arranged to provide for a pressure drop of less than 50 psi across the entire zone. The coalesced portion is then separated from the remainder.

U.S.P. 2,494,546. Separation of Olefins. E. V. Fasce to Standard Oil Development Company.

A mixture of hydrocarbons containing butene-1 and butene-2 is contacted with a cuprous ammonium salt solution at a temperature of −29° to +38° C. and a pressure from atmospheric to 200 psi. The extract solution formed contains the butene-1, while the raffinate contains the butene-2. If butadiene was also present in the hydrocarbon mixture, it will be

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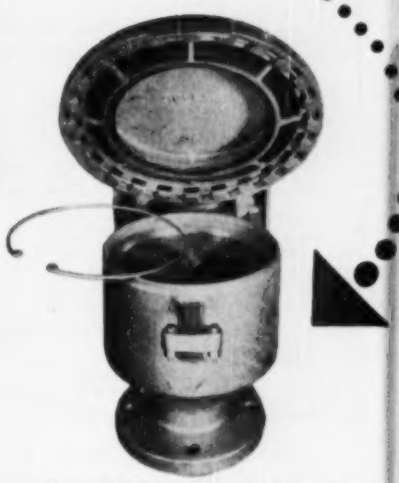

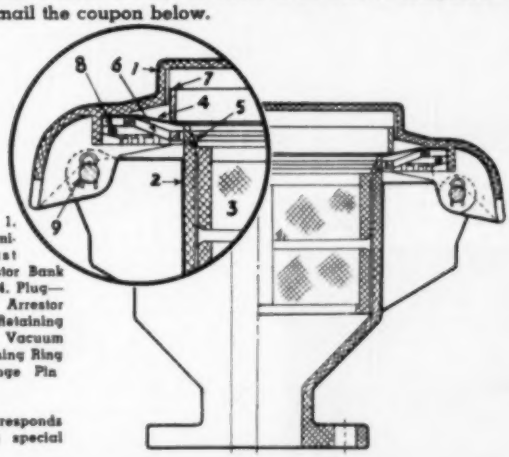

SPECIFICATIONS: 1. Cover — Cast Aluminum. 2. Body — Cast Iron. 3. Flame Arrestor Bank —Rolled Aluminum. 4. Plug—Synthetic Rubber. 5. Arrestor Spring — Steel. 6. Retaining Ring—Aluminum. 7. Vacuum Ring—Steel. 8. Retaining Ring Spring—Steel. 9. Hinge Pin — Stainless Steel.

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Valve Inch Size	Opening Pressure Ounces		Vacuum Opening Ounces
	Minimum	Maximum	
2	3.2	18	0.5
3	3.2	16	0.5
4	2.5	16	0.5
6	2.5	16	0.5
8	2.0	16	0.5
10	2.0	16	0.5
12	2.0	10	0.5
16	2.0	8	0.5
20	2.0	6	0.5
24	1.5	4	0.5

NOTE: Pressures in this table are for cast aluminum cover, and they will differ from other metals. Pressure ratings require a manufacturing tolerance of plus or minus 5 per cent. Vacuum opening can be increased.

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- ☐ Please have a BS&B SAFETY HEAD engineer analyze my relief problem, without cost, or obligation to me.

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Call on *R-C dual-ability* to move air or gas in any quantities for industrial uses

When you have a job of handling gas or air, in quantities from 5 cfm to 100,000 cfm, Roots-Connersville will do it efficiently and economically. With many sizes and types, we can match blowers, exhausters and gas pumps closely to the job, to reduce first cost and operating costs.

R-C *dual-ability* offers you the exclusive, *dual* choice between Centrifugal and Rotary Positive designs. You can select single-stage or multi-stage units, from our standard lines, with flexibility as to drives and other accessories to meet your needs.

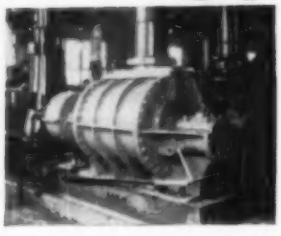
To aid in your specifications, our air-and-gas specialists are at your service. With nearly a century of experience behind them, they can help you solve almost any problem of handling air or gas.

ROOTS-CONNERSVILLE BLOWER CORPORATION
504 Crescent Avenue, Connersville, Indiana

Type OI Centrifugal Blower in oil refinery operation. Capacity 11,750 cfm.

Rotary Positive Gas Pump for handling refinery gas. Capacity 3,100 cfm.

ROTARY



ROOTS-CONNERSVILLE

BLOWER BUILDERS SINCE 1854

ONE OF THE DRESSER INDUSTRIES

Patents

contained in the extract solution and can be separated from the butene-1 by further treatment of this solution. Butanes and isobutylene present in the hydrocarbon mixture will be found in the raffinate fraction.

U.S.P. 2,495,549. Separation of Ternary Gaseous Mixtures Containing Hydrogen and Methane. I. Roberts to Elliott Company.

For separating the constituents of a ternary gaseous mixture containing hydrogen and methane and a constituent of an intermediate b.p., and particularly for separating hydrogen and methane from coke oven gas and the like, the mixture is compressed and then cooled in at least three stages to liquefy all constituents with the exception of hydrogen. The liquefied constituents are used to condense liquid reflux for rectifying them, and they are rectified to obtain substantially pure liquid methane and a gas of intermediate b.p. This gaseous constituent is further treated and used as a cooling agent in the first cooling stage, while the liquid methane is used in the second cooling stage, and the hydrogen is used as a cooling agent in the first and third stages.

U.S.P. 2,495,555. Diesel Fuel. D. R. Stevens to Gulf Research & Development Company.

A hydrocarbon Diesel fuel is compounded with a minor proportion of a sulfurized cracked petroleum distillate in an amount sufficient to improve the ignition qualities of the fuel. The additive shall contain 15-40 percent of combined sulfur and is obtained by heating a cracked petroleum distillate with elemental sulfur to a temperature above the melting point of sulfur but not above 350° F.

U.S.P. 2,495,842. Fractionation of Gases with Solid Adsorbents. E. R. Gilliland to Standard Oil Development Company.

C_6 and C_7 hydrocarbon fractions are separately concentrated from a gas mixture containing C_5-C_8 hydrocarbons by means of a granular solid adsorbent in a process claimed in detail.

U.S.P. 2,495,850. Process of Extracting Aromatic Hydrocarbons. A. P. Lien and B. L. Evering to Standard Oil Development Company.

A mixture of liquid aromatic and non-aromatic hydrocarbons is extracted at a temperature of 50-150° F. with a complex of BF_3 and an oxygenated organic compound in sufficient quantity to form a diphasic separation. A fraction comprising essentially the non-aromatics and a minor amount of the complex is thus separated from a fraction comprising essentially aromatics dissolved in the complex. Oxygenated alkanes, such as ethyl acetate or ethyl ether, are examples of the useful organic compounds.

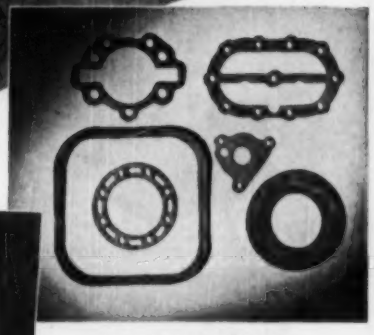
U.S.P. 2,495,852. Decolorizing Organic Substances. A. P. Lien, B. L. Evering, and B. H. Shoemaker to Standard Oil Development Company.

The same complex as in U.S.P. 2,496,851 is here employed in the presence of an aliphatic hydrocarbon diluent for decolorizing hydrocarbon oil.

U.S.P. 2,496,107. Recovery of Cyclopen-

QUESTION:

Which Garlock gasket sheet is recommended for hot oils, steam or hot gases up to 700° F?



ANSWER:

Garlock 7021

Above: GARLOCK 7021 Compressed Asbestos Sheet. Thicknesses $\frac{1}{64}$" to $\frac{1}{4}$". Sheets 40" x 40" and larger. *Below:* GARLOCK 7022, Gaskets cut from 7021 sheet; all sizes and shapes.

GARLOCK 7021 Compressed Asbestos Sheet Packing is an ideal gasketing material for use against high temperatures and extreme pressures. It is sufficiently compressible to compensate for normal irregularities in flange faces but resistant to plastic flow under heavy bolt loads. Specially recommended for severe oil and steam service. A Garlock representative will call upon request.

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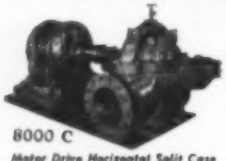


8000 C

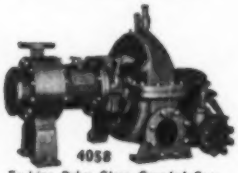
Motor Drive Horizontal Split Case Double Suction Centrifugal Pump

8001

Turbine Drive Horizontal Split Case Multi Stage Centrifugal Pump

4049 A

Two Stage Close Coupled Centrifugal Pump



4058

Turbine Drive Close Coupled Centrifugal Pump

942

Single Style, Packed Piston Pattern Steam Pump

2352 B

Durable Duplex, Outside End Packed, Plunger Pattern Steam Pump

2918

Durable Duplex, Packed Piston Pattern Steam Pump

3833

Horizontal Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

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Patents

tadiene. W. D. Spaulding and B. K. Wasserkrug to National Steel Corporation.

Cyclopentadiene is separated from a fraction of the by-product light oil from coke ovens, having a boiling range near to that of cyclopentadiene, by passing this fraction into a polymerization zone where it is maintained in vapor phase at a temperature of 150-275°C. for a time sufficient to polymerize cyclopentadiene to dicyclopentadiene, but insufficient for higher polymerization. The reaction effluent is cooled to a temperature of 40-170°C. to condense and collect dicyclopentadiene.

U.S.P. 2,496,207. Azeotropic Distillation of Hydrocarbons from Sulfolanes. A. E. Handlos and G. J. Pierotti to Shell Development Company.

Sulfolanes, employed for example as solvents in the separation of hydrocarbon mixtures, are removed from a hydrocarbon fraction of near b.p. range with the sulfolane by distilling the mixture in the presence of certain aliphatic alcohols as azeotrope former of special properties.

U.S.P. 2,496,354. Method of Inhibiting Hydrogen Sulfide Corrosion of Metals. M. I. Moyer and J. M. Hersch to Cities Service Oil Company.

H_2S containing brines obtained in the production of crude oil are mixed with a small proportion of melamine to substantially inhibit the corrosion of oil production and transport equipment.

U.S.P. 2,496,444. Diesel Fuel. F. V. Cook to Standolind Pipe Line Company.

An injector engine fuel consists of a sour hydrocarbon oil boiling in the diesel fuel range and an amount of 0.002-2 percent by volume of formaldehyde to render the oil non-corrosive to ferrous metal.

U.S.P. 2,496,594-6. Formaldehyde Corrosion Inhibitor Compositions. M. I. Moyer and J. M. Hersh to Cities Service Oil Company.

The processes according to these patents are related to that of U.S.P. 2,496,354. According to 2,496,594 a composition comprising 5-20 parts of formaldehyde and 1 part of ammonia is used as the corrosion inhibitor; according to 2,496,595 an aqueous solution of 3-40 parts of formaldehyde and one part of hexamine is employed; and according to 2,496,596 various other amino-reactive compounds are used in combination with formaldehyde.

DESULFURIZATION

U.S.P. 2,494,687. Oxidation of Mercaptans in the Presence of C-Nitroso Aromatic Compounds. D. C. Bond to The Pure Oil Company.

A hydrocarbon liquid containing mercaptans is intimately contacted with air and alkali solution containing a small amount of a C-nitroso compound of an aromatic amine or a phenol in which amino groups of the amines and hydroxyl groups of the phenols are ortho or para to other amino or hydroxyl

from these laboratories

Two views of the INSUL-MASTIC laboratories at Summit, Illinois

come the most dependable COATINGS known to industry

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Here, at Summit, Illinois, a suburb of Chicago, modern equipment in a modern building produces INSUL-MASTIC, the most dependable coatings known to industry.

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Quality coatings can only be produced from materials of proven worth and to insure INSUL-MASTIC quality, high percentages of Gilsonite and carefully chosen and tested flake mica are used, together with other proven ingredients.

INSUL-MASTIC coatings have been specified by industry as a result of long and rigid testing—meeting the most exacting demands.

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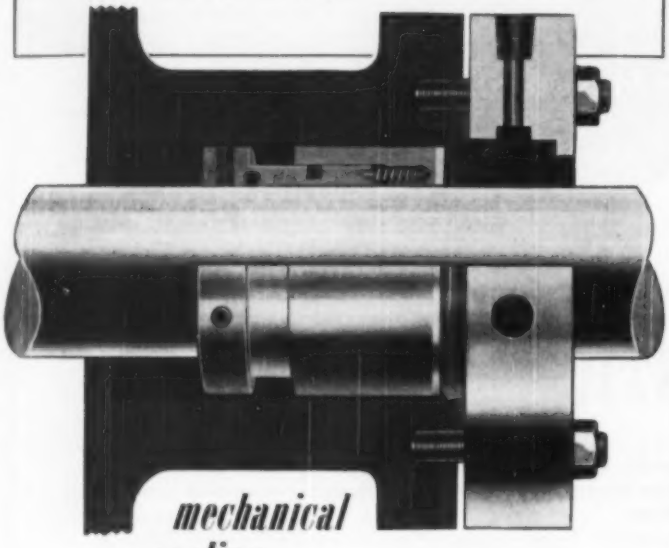
A New Achievement In High Pressure Sealing for Light Hydrocarbons



mechanical sealing at its best... DURA SEAL *TYPE-P.S.*

Perfect **S**ealing on pumps handling light hydrocarbons is being recorded wherever this new custom-built mechanical seal is being used. DURA SEAL —Type P.S. provides non-lubricated sealing up to 600 lb. pressures. Consider, and compare, these features: It can be installed on your present equipment . . . requires no special sleeves or machining . . . no added lubrication system is needed . . . made of selected materials to operate under YOUR particular conditions.

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NEWARK • NEW ORLEANS • PITTSBURGH • PORTLAND, ORE. • ST. LOUIS • SALT LAKE CITY
SAN FRANCISCO • SEATTLE • TULSA • YOUNGSTOWN

Patents

groups in the benzene ring. p-Nitroso phenol and o-nitroso m-cresol are examples of these compounds. They promote the oxidation of the mercaptans to disulfides. Alkali solutions containing mercaptan extracted from hydrocarbons can be regenerated by this method.

U.S.P. 2,495,851. Desulfurization of Organic Substances. A. P. Lien and B. L. Evering to Standard Oil Development Company.

The same type of extraction solvent complex as in U.S.P. 2,495,850 is employed under identical conditions for desulfurizing a sulfur-bearing hydrocarbon material. The oxygenated alkane compound employed in this case in the solvent complex shall not have more than about 5 C atoms in the alkyl group, and the BF_3 in the complex shall be present in excess.

U.S.P. 2,496,536. Desulfurization of Crude and Cracked Petroleum Distillates. C. O. Hoover to Air Reduction Company, Inc.

For reducing the sulfur content of crude and cracked petroleum distillates, its vapors and those of a carboxylic acid, e.g. naphthenic acid, are intimately contacted with pieces of cuprous material. A copper compound of the acid is formed which reacts with the sulfurous material in the distillate to form stable copper-sulfur compounds and to liberate the organic acid which is contacted with more cuprous material for further desulfurization of the distillate.

HEAVY OILS AND WAXES

U.S.P. 2,494,332. Extreme Pressure Lubricants. E. B. Cyphers to Standard Oil Development Company.

An extreme pressure additive for mineral oil base lubricants consists of a material of the formula $R_c—S—P(=S)(—OR_r)(—OR_s)$ wherein R_r is a halogenated resin ester, and R_s and R_s are aliphatic hydrocarbon groups of 2-10 C atoms each.

U.S.P. 2,494,341. Lubricant Composition. E. Lieber to Standard Oil Development Company.

A lubricant comprises a major proportion of a waxy mineral lubricating oil and a pour-depressor consisting of an oil-soluble condensation product of 0.5-5 mols of an alkyl mercaptan having 1-20 C atoms, with 1 mol of an aromatic hydrocarbon with less than 20 C atoms or an hydroxy derivative thereof.

U.S.P. 2,495,030. Flushing Oil. J. W. Starrett to Standard Oil Company (Indiana).

A flushing oil consists essentially of a catalytically reformed naphtha fraction boiling between 300-650°F. and composed predominantly of mono- and poly-methylated ar. hydrocarbons, and 1-20 percent of a neutralized P- and S-containing reaction product of a phosphorous sulfide and an olefin polymer with a mol. wt. of 150-50,000.

U.S.P. 2,495,478. Mineral Oil Composi-

For positive valve sealing

...THE UNCONDITIONAL K & M BELLOWS SEAL!

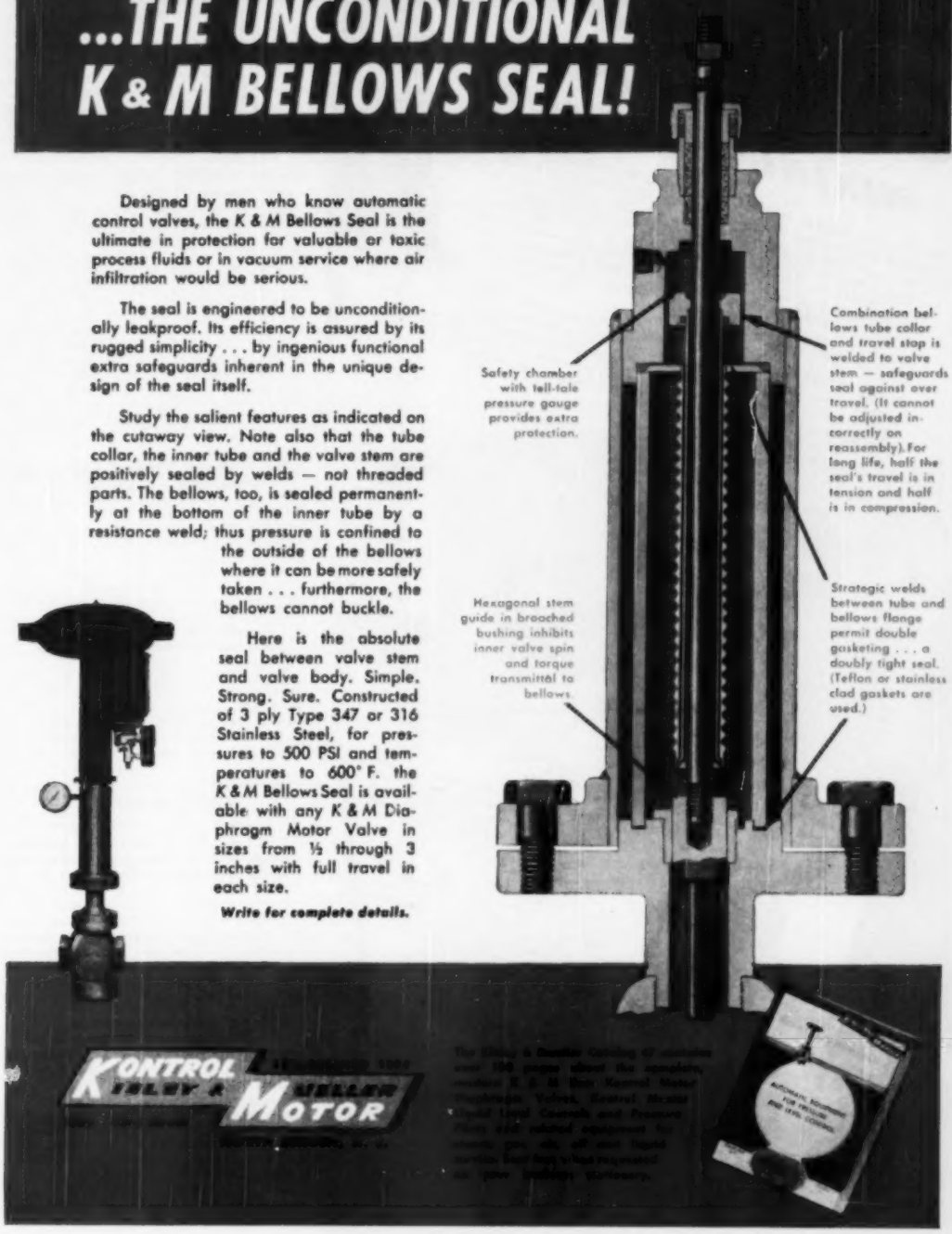
Designed by men who know automatic control valves, the *K & M* Bellows Seal is the ultimate in protection for valuable or toxic process fluids or in vacuum service where air infiltration would be serious.

The seal is engineered to be unconditionally leakproof. Its efficiency is assured by its rugged simplicity . . . by ingenious functional extra safeguards inherent in the unique design of the seal itself.

Study the salient features as indicated on the cutaway view. Note also that the tube collar, the inner tube and the valve stem are positively sealed by welds — not threaded parts. The bellows, too, is sealed permanently at the bottom of the inner tube by a resistance weld; thus pressure is confined to the outside of the bellows where it can be more safely taken . . . furthermore, the bellows cannot buckle.

Here is the absolute seal between valve stem and valve body. Simple. Strong. Sure. Constructed of 3 ply Type 347 or 316 Stainless Steel, for pressures to 500 PSI and temperatures to 600° F. the *K & M* Bellows Seal is available with any *K & M* Diaphragm Motor Valve in sizes from ½ through 3 inches with full travel in each size.

Write for complete details.


Safety chamber with tell-tale pressure gauge provides extra protection.
Combination bellows tube collar and travel stop is welded to valve stem — safeguards seal against over travel. (It cannot be adjusted incorrectly on reassembly). For long life, half the seal's travel is in tension and half is in compression.
Hexagonal stem guide in broached bushing inhibits inner valve spin and torque transmittal to bellows.
Strategic welds between tube and bellows flange permit double gasketing . . . a doubly tight seal. (Teflon or stainless clad gaskets are used.)
KONTROL VALVE & BELLOW MOTOR

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MIXING EQUIPMENT

For the most efficient, rapid and economical blending of gasoline, gasoline Ethyl mixing, lubricating and fuel oil blending, as well as by-products, liming, caustic and Doctor treating—indispensable in cycling operations and pipe line work—uniformity in charging stock—mud mixing—a natural for research, laboratory and pilot plants, INTERNATIONAL presents a complete line of Side Entrance and Top Entrance Mixers from continuous heavy duty high pressure 24-hour service, to types for less exacting requirements at lower initial cost (see types "NU" and "NUB" below).

INTERNATIONAL TOP ENTERING MIXERS for closed or open vessels, for heavy duty or standard operations. Available in all stuffing box, shaft and stirrer materials—direct or gear motor drives using turbines or propellers. Units come completely assembled, ready for use with either American standard flanges or special flanges and drilling to meet any requirements.

INTERNATIONAL Side Entrance Mixers shown here are equipped with Heavy Duty Ball Thrust Bearings. No Thrust on Gears or Motor.

INTERNATIONAL Side Entrance Mixers are fitted with a simple leak-proof type proven arrangement for packing from tank outside.

TYPE "NU"

TYPE "NU"—all steel welded construction, gear motor drive. No cast parts—three bearing supports to Mixer shaft (two ball bearings and one single lantern bearing). Suitable for all installations not requiring a double lantern box—less original cost—all standard sizes from ½ to 30 horsepower.

TYPE "NUB"—V-belt or Chain Drive—a short coupled, all welded construction less expensive Mixer with its other characteristics the same as the "NU"—sizes ½ to 30 horsepower. (See catalog No. 72 for the "NT" and the "NS" Heavy Duty Mixers).

TYPE "NUB"

Call on INTERNATIONAL'S vast experience for assistance in solving your mixing and blending problems. Our Engineering staff is at your service—write for catalogs and complete information on Top Entering, Side Entrance and Portable Mixers, which are free for the asking, and no obligation, of course.

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Patents

tion. H. E. Redman to Socony-Vacuum Oil Company, Inc.

A mineral oil fraction contains 0.1-10 percent of an oil-soluble metal salt of an acidic P- and S-containing reaction product obtained by reacting at a temperature of 100-175°C. a phosphorus sulfide and an alkyl-nuclear-substituted primary or secondary aromatic amine or an alkyl-N-substituted secondary amine. The alkyl substituent of these compounds shall have at least 10 C atoms.

U.S.P. 2,495,651. High Temperature Ball-Bearing Grease. R. A. Butcosk to Socony-Vacuum Oil Company, Inc.

A lubricating grease, suitable for the lubrication of ball bearings, roller bearings, and the like at high temperatures, comprises a major proportion of a mineral lubricating oil and 15-30 percent of an alkali metal soap of a fatty acid having an iodine number of 60-170. The grease is compounded by incorporating the acid-containing ingredient in at least a portion of the oil, saponifying, and then raising the temperature of the mix slowly to 500-540°F. and thereafter holding this temperature for at least 20 minutes to bring about substantial polymerization of the fatty acid component.

U.S.P. 2,496,508. Stabilized Organic Sulfur-Containing Compounds. R. W. Watson and L. W. Mixon to Standard Oil Company (Indiana).

A lubricant consists of a major proportion of hydrocarbon oil, an organic sulfur compound which evolves H_2S, and 0.001-5 percent (by weight of the latter) of an aliphatic epoxide, e.g. epichlorohydrin.

U.S.P. 2,496,798. Rust-Inhibiting Lubricating Composition. H. D. Kluge to The Texas Company.

A lubricating mineral oil is compounded with 0.01-3 percent by weight of a tert. dodecyl thiosuccinic acid of special constitution. The additive inhibits the formation of ferric oxide rust on steel in the presence of salt water.

PETROCHEMICALS

U.S.P. 2,494,758. Condensation of Aldehydes with Aromatics or Thiophenes in the Presence of Glauconite. H. D. Hartough and J. J. Sardella to Socony-Vacuum Oil Company, Inc.

Aromatic hydrocarbons or thiophenes are reacted with formaldehyde in the presence of glauconite at temperatures of 150-500°F. at autogenous pressures and in the absence of water. Sub-resinous and resinous materials are produced.

U.S.P. 2,495,286. Interpolymers of Carbon Monoxide and Method for Preparing the Same. M. M. Brubaker to E. I. du Pont de Nemours & Company.

A mono-olefin is heated with CO in the presence of a peroxy compound catalyst and in the absence of a Friedel-Crafts catalyst under increased pressure at a temperature of 25-350° C. An interpolymer of olefin and CO is obtained.

U.S.P. 2,495,332. Oxidation of Hydrocarbons. M. H. Kotzebue to Celanese

Corporation of America.

Hydrocarbons are subjected to an initial partial oxidation with oxygen containing an inert gaseous diluent at increased pressure under such conditions that a temperature of 600-900° F. is developed and maintained. The resulting gaseous reaction mixture is further oxidized with added oxygen free of inert diluent, whereby a temperature higher than that of the initial stage is produced. Partial cracking of unreacted hydrocarbons present and formation of additional oxygenated organic compounds is effected in the second stage.

U.S.P. 2,495,567. Preparation of Acid Derivatives from Unsaturated Compounds. M. Carmack and D. L. F. DeTar to Rohm & Haas Company.

An alkene or an arylalkene, e.g. styrene, is heated with aqueous ammonium polysulfide to a temperature above 110° C. Carboxylic acid amides, e.g. phenyl acetamide, are produced. On heating an arylalkene with sulfur and morpholine in proportions such that the mixture contains sulfur and morpholine in amounts more than equivalent to the hydrocarbon, a thioamide of a monocarboxylic acid is obtained.

U.S.P. 2,495,665. Apparatus for Producing Acetylene. O. Spring to Danciger Oil & Refining Company.

Details of an apparatus are claimed for the production of acetylene by the incomplete combustion of hydrocarbons. This apparatus makes possible a homogeneous and substantially instantaneous mixing of the hydrocarbons and air, resulting in a much more nearly quantitative pyrolytic reaction. Decomposition of the formed acetylene is inhibited by quickly quenching the reaction products.

U.S.P. 2,496,251. Alcohol Process. H. O. Mottern to Shandard Oil Development Company.

A hydrocarbon stream containing normal olefins and 2-14 percent tert. olefins is contacted with strong mineral acid in an absorption zone. An acid extract phase of the normal olefin and a hydrocarbon phase containing dissolved dialkyl ester of the normal olefin and the mineral acid are formed. On hydrolyzation of the extract phase sec. monohydric aliphatic alcohol is recovered. A hydrocarbon solution of said dialkyl ester and traces of strong mineral acid are added to the hydrocarbon stream prior to its introduction into the absorption zone, whereby the formation of polymers can be substantially restricted.

U.S.P. 2,496,358. Process for Producing Condensation Products. J. Ross and A. I. Gebhart to Colgate-Palmolive-Peet Company.

Peroxide-contaminated olefins are treated by chemical reaction to destroy the peroxides. The treated material is distilled to recover purified olefins and then heated with a compound having an alpha-beta-enal group and up to 7 C atoms, e.g. with maleic anhydride, in about stoichiometric proportions at a temperature of 150-250° C. for 1-4 hours. Simple condensation products of said compound with the olefin are produced in high yield.

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SPECIFY **Pacific**

Precision Built

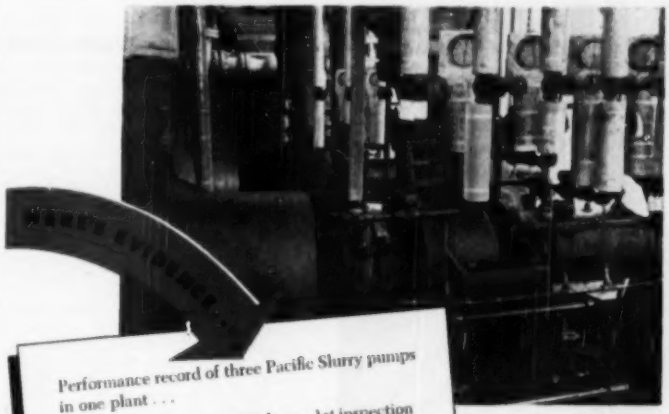
SLURRY PUMPS

1 Pacific's special design provides maximum protection for wearing rings, shaft sleeves and packing.

2 Precision workmanship insures the perfect fit necessary to prevent destructive cutting of parts caused by leakage from high to low pressure areas.

3 All parts are fabricated from materials selected for strength, toughness and resistance to erosion and corrosion.

A combination that decreases frequency of down time, decreases frequency of parts renewal and decreases maintenance cost.



Performance record of three Pacific Slurry pumps in one plant . . .

1st run—on stream . . 270 days—1st inspection
2nd run—on stream . . 420 days—no inspection
3rd run—on stream . . 420 days
Total On Stream . . 1110 days—2nd inspection

1st inspection made on 1 pump only. No parts were replaced as the condition of the pump was perfect.

On the 2nd inspection each pump was examined. Wearing rings and shaft sleeves were replaced in all 3 pumps and the impeller in one.

Exceptional Performance? No . . . just average!

Write for Bulletin 86A

PR-10

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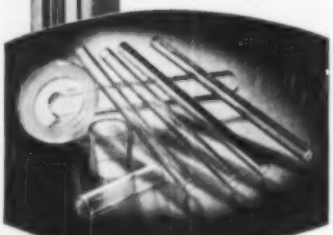
FLAT GAUGE GLASSES
for high pressure boiler service

Two types of MACBETH brand Flat Gauge Glasses available for high pressure service—Type A (Plain) use in pairs with water column between—Type B (Reflex) with full length prisms—use singly with prisms on water side.

Made of hard, chemically resistant glass.

Outlast all other types. Designed for pressures up to 1500 p.s.i. for steam boiler use, and up to 5000 p.s.i. at normal temperatures.



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CORNING
GLASS WORKS
CORNING, N.Y.
PYREX

Patents

U.S.P. 2,496,621. Catalytic Hydration of Olefins. R. F. Deering to Union Oil Company of California.

Olefins are contacted in the presence of 15-75 percent water vapor with a hydration catalyst comprising an oxygen-containing phosphorus acid or mixtures of such acids and minor proportions of metal salts thereof, distended on a silica support. Details of the preparation of this catalyst are claimed.

U.S.P. 2,496 659. Production of Nitriles. W. I. Denton and R. B. Bishop to Socony-Vacuum Oil Company, Inc.

An olefin with up to 10 C atoms is contacted with gaseous ammonia at a temperature of 850-1075° F. in the presence of a metal salt of molybdic or tungstic acid. Nitriles with at least 2 C atoms are produced.

U S.P. 2,496 660. Production of Aromatic Nitriles. W. I. Denton and R. B. Bishop to Socony-Vacuum Oil Company, Inc.

The process according to this patent is closely related to that of U. S. P. 2,496,659. Toluene, xylenes, trimethyl benzenes, or styrene are here employed as the charge. Uranyl or iron molybdate are used as catalysts. Aromatic nitriles are formed.

U.S.P. 2,496,661. Production of Nitriles. W. I. Denton to Socony-Vacuum Oil Company, Inc.

A process similar to that of U.S.P. 2,496,660 is employed for the manufacture of nitriles from certain other alkyl-substituted aromatic hydrocarbons. The process, however, is not restricted to the use of any special catalysts.

U.S.P. 2,496,669. Copolymerization of Thiophene with Styrene. J. R. Meadow and A. A. O'Kelly to Socony-Vacuum Oil Company, Inc.

Thiophene and styrene in a mol ratio of 1-3:3-1, respectively, are contacted in the presence of HF in amounts of 1-25 percent of the thiophene. Synthetic resins are obtained.

U.S.P. 2,496,697. Styrene-Substituted Benzalacetophenone Copolymers. F. C. Chapin to Monsanto Chemical Company.

Fifty to 98 percent of styrene and 50-2 percent of a benzalacetophenone are mixed and heated in the presence of a peroxide catalyst. Copolymers of high heat distortion points and high softening points are obtained.

POLYMERIZATION AND CONVERSION

U.S.P. 2,493,948. Copolymers of Diallyl Fumarate and Styrene. R. E. Davies and A. R. Esterly to Catalin Corporation of America.

A mixture of 17-80 percent of diallyl fumarate and 83-20 percent of styrene is copolymerized under special conditions in the presence of an organic peroxide catalyst.

U.S.P. 2,493 965. Emulsion Polymerization of Styrene. J. W. Haefele to U. S. Rubber Company.

In the emulsion polymerization of styrene, a mixture of styrene and certain phthalate- or triarylphosphate-plasticizers is employed in the presence of specific proportions of an alkali soap of a fatty acid with 12-24 C atoms, alkali sulfate, and alkali dodecyl benzene sulfonate to obtain a polystyrene emulsion with high solids content which does not coagulate prematurely.

U.S.P. 2,494,326. Emulsion Polymerization Process. E. Arundale to Standard Oil Development Company.

In the emulsion polymerization of a conjugated diolefin with 4-6 C atoms, alone or in mixture with styrene or acrylonitrile, 0.125-1.0 percent of an aliphatic mercaptain mixture consisting of 55 percent dodecyl, 30 percent tetradecyl, and 15 percent hexadecyl mercaptan is used as polymerization modifier. Rubber-like materials of improved uniformity and better physical properties are obtained.

U.S.P. 2,494,337. Apparatus for Contacting Finely Divided Solid Particles with Gaseous Materials. C. E. Hemminger to Standard Oil Development Company.

Details are claimed of an apparatus for treating vapors or gases with finely divided solid contact material, particularly in the conversion of hydrocarbons. The vapors or gases are passed through the reaction zone countercurrent to the flow of the contact material, and the velocity of the gases is so adjusted that the solid particles are fluidized. Contacting means are provided in the reaction zone to insure intimate contact between the solids and the gases.

U.S.P. 2,494,510. Polymerization of Propylene in the Presence of Isobutane. E. C. Hughes and H. M. Stine to The Polymerization Process Corporation.

A reaction charge of propylene and isobutane free of butylene and containing 5-50 percent by weight of the isobutane is passed over a phosphoric acid or phosphate catalyst at a temperature of 350-500° F. and a pressure of 200-1500 psi. Normally liquid olefinic polymers of propylene are formed which are useful as a motor fuel component. The isobutane remains substantially unreacted.

U.S.P. 2,494,556. Treating Clay Catalysts Used for Conversion of Sulfur Containing Feeds. G. F. Hornaday to Houdry Process Corporation.

In the conversion of a hydrocarbon charge stock containing at least 1.5 percent sulfur to hydrocarbons of improved motor fuel value in the presence of a clay catalyst containing iron compounds, the catalyst is passed from a conversion zone, where it is contacted with the charge at cracking temperatures and the iron compounds are converted to iron sulfide, to a regeneration zone where the catalyst is contacted with an oxygen-containing gas to burn off carbonaceous deposit. The regenerated catalyst is recycled to the conversion zone after a portion of the catalyst has been freed

CASE HISTORY

How Du Pont Service Solved a Tetraethyl Lead Storage and Handling Problem

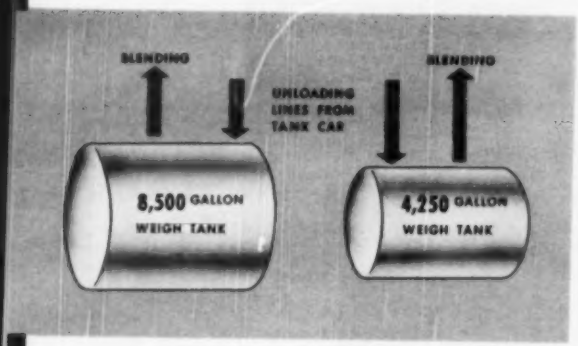
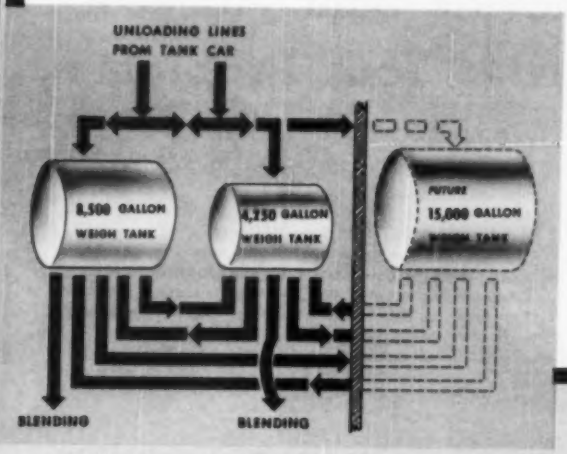


Diagram showing original set-up of TEL weigh tanks in large refinery. Operation of blending plant was inflexible because each tank could only be used individually.



Blending plant diagram after redesign by Du Pont TEL operating division. Complete flexibility was obtained as well as provision for future expansion when desired.

A large refinery was using two tetraethyl lead weigh tanks which had been installed at different times as the plant increased in size. Because each tank had been set up as a separate unit when put in, blending operations were not as flexible as desired.

As demands on the blending equipment increased the refiner sought some method of improving the flexibility of his present TEL blending plant and at the same time provide for the addition of expanded storage and weigh tank facilities.

The Du Pont field representative was called in for his recommendation. After careful analysis of the problem, he made a proposal which:

1. Gave maximum flexibility and economy through modernization of present installation. Provision was made to use existing fittings and other parts wherever possible to keep cost at a minimum.

2. Also provided for future installation of additional weigh tank to handle long range growth. Design enabled new facilities to be hooked into present ones when built, but did not require that money be spent for new storage until needed.

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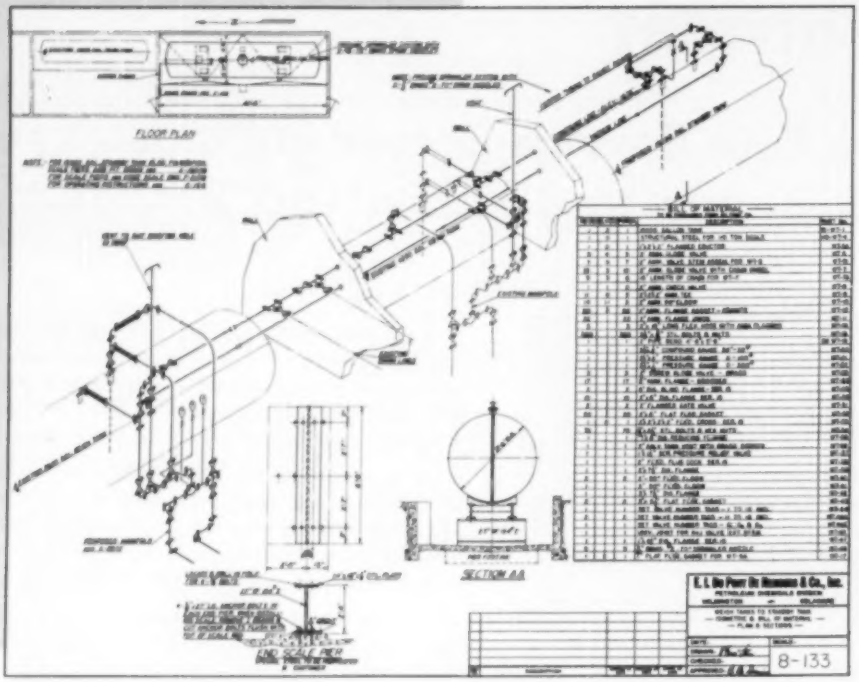

Du Pont provides complete design service for all TEL handling problems. Valves, fittings and other special parts for blending plant construction, repair and modernization may also be obtained from Du Pont.

Du Pont Services Provide Safe, Practical, Economical Solutions to Your Problems

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Du Pont developed "Nitramon" S, a blasting agent for seismic exploration? These special blasting agents which go under the trade names "Nitramon" S and "Nitramon" WW cannot be detonated even with a rifle bullet. They require a special primer. Blasting agents and explosives are only a few of the many Du Pont products used throughout the oil industry from oil location to finished product.

This case history, where the Du Pont field representative was able materially to improve the flexibility of an existing installation, and provide for future expansion is but another example of Du Pont TEL services in action.

Whenever you have a problem involving TEL handling, blending or storage, call your Du Pont Petroleum Chemicals Representative. His recommendation, based on experience in handling a wide variety of such problems, will offer a safe, practical and economical solution.

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A-429

of iron sulfide and then returned to the system.

U.S.P. 2,494,585. Olefinic Polymerization in the Presence of Fluorine Compounds. J. S. Saylor Jr. to Standard Oil Development Company.

A mixture of an isoolefin with 4-7 C atoms, e.g. isobutylene, and a polyolefinic hydrocarbon with 4-14 C atoms, e.g. isoprene, is kneaded at a temperature of —20° to —164°C. in the presence of a Friedel-Crafts catalyst and a chlorofluoro alkane which is solid at the reaction temperature and volatile below 100°F., e.g. dichlorotetrafluoroethane.

U.S.P. 2,494,695. Pyrolytic Conversion of Hydrocarbons with Recovery of Coke. F. R. Fisher to Sinclair Refining Company.

A hydrocarbon charge oil is passed in contact with a bed of metal balls maintained at coking temperature and a pressure of 100-500 psi. until a heavy coke deposit is formed on the balls. On suddenly releasing the pressure, the coke is broken and can then be easily separated from the balls.

U.S.P. 2,494,924. Polymerizing Styrene in Iron Vessels. J. L. Amos and K. E. Stober to The Dow Chemical Company.

Details are claimed of a process for the mass polymerization of monovinyl aromatic compounds of the benzene series in closed iron vessels.

U.S.P. 2,495,133. Treating Hydrocarbons with Hydrofluoric Acid. J. A. Ridgway Jr. to Pan American Refining Corporation.

The effluents of the conversion of heavy hydrocarbon oil by HF are separated into an oil phase and a HF phase. Both phases are subjected to further treatment to recover the conversion product and a HF-soluble oil containing absorbed HF which is recycled.

U.S.P. 2,495,137. Polymerization of Butadiene. G. P. Rowland Jr. to The Firestone Tire & Rubber Company.

In the polymerization of butadiene, a surface is coated with a solvent cement of a previously formed butadiene polymer having suspended therein finely divided sodium in an amount of 0.5-10.0 percent of the polybutadiene ultimately produced. The solvent is evaporated from the cement. The thus obtained coating, a polybutadiene with suspended sodium therein, is contacted with gaseous butadiene to be polymerized.

U.S.P. 2,495,262. Catalytic Treatment and the Regeneration of Catalyst in Stationary Beds. P. C. Keith to Hydrocarbon Research, Inc.

A charge stock, e.g. gasoline hydrocarbons obtained by a Fischer-Tropsch synthesis, is supplied under reaction conditions to an intermediate portion of a catalyst mass and directed toward one extremity thereof. A regenerating agent is introduced at the other extremity of this mass. Reaction and regeneration products are withdrawn together from the first-named extremity. The flow of the reactant feed through the mass is periodically reversed.

U.S.P. 2,495,648. Hydrocarbon Treating Process. H. H. Voge, G. M. Good, and B. S. Greensfelder to Shell Development Company.

A mixture of straight chain olefin and an isomeric branched chain olefin with 4-6 C atoms is contacted with a silica-alumina, silica-magnesia, silica-zirconia-alumina, or alumina-boria, or an activated clay cracking catalyst at a temperature of 300-450°C. and a pressure of 1-10 atms. These conditions are correlated so that excessive cracking of the olefins is avoided. The contacting is discontinued when the bromine number of the product corresponds to the content of the straight chain olefin in the mixture. The branched chain olefin is thus selectively converted to the corresponding isoparaffin, while the straight chain olefin is recovered in concentrated form. The required hydrogen is supplied by decomposition of some of the olefin or from an added hydrogen donor, such as cyclohexane.

U.S.P. 2,496,222. Continuous Process for Emulsion Polymerization of Unsaturated Compounds. E. C. H. Kolvoort and G. Akkerman to Shell Development Company.

A non-acidic emulsion in water of a vinylidene compound with one single $CH_2{=}C\langle$ group as the only C to C unsaturation contains as emulsifier an alkali metal salt of a hydrocarbon sul-

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Patents

fate or sulfonate wherein the hydrocarbon radical contains 10-20 C atoms. This emulsion is introduced into one end of a reaction space with the addition of a peroxide catalyst and sufficient water-miscible acid to obtain a pH of 1.5-4 in the emulsion and is passed through this space under polymerizing conditions at such a rate that at least 40 percent of the vinylidene compound is polymerized. The emulsified polymer is continuously withdrawn from the other end of the space.

U.S.P. 2,496,390. Cyclic Ether Peroxide Catalyst in the Polymerization of Conjugated Diolefins. H. M. Guinot to Les Usines de Melle (Soc. Anon.).

Polymerization of conjugated diolefins is effected in the presence of a peroxide of a cyclic ether, the carbon-oxygen nucleus of which contains two oxygen atoms and 3-6 C atoms, at least two of these C atoms being directly linked together.

U.S.P. 2,496,653. Continuous Bulk Polymerization of Styrene. I. Allen Jr., W. R. Marshall and G. E. Wightman to Union Carbide & Carbon Corporation.

Details are claimed of a continuous process for polymerizing styrene in a closed system. No solvents, stabilizers, emulsifiers, or the like need be added for the operation of this process.

U.S.P. 2,496,864. Emulsion Polymerization of Styrene. E. F. Fiedler and G. R. Lucas to General Electric Company.

Details are claimed of a process for the production of crystal-clear polystyrene free of discoloration by emulsion polymerization of styrene.

HYDROGENATION, DEHYDROGENATION, AROMATIZATION

U.S.P. 2,493,917. Catalytic Conversion. R. J. Hengstebeck to Standard Oil Company of Indiana.

In a Fischer-Tropsch synthesis process, an annular bed of catalyst is rotated in the conversion zone and is maintained there partially immersed in a liquid which is inert with respect to the catalyst. The CO/H_2 mixture is continuously passed through the non-immersed portion of the bed under conversion conditions. The liquid can either be a cooling liquid, and the bed is then rotated at a rate sufficient to prevent overheating of the catalyst. In this case the liquid can be at least partially vaporizable under conversion conditions, so that cooling is effected by partial vaporization of this liquid. Or, the liquid can be a solvent for contaminants deposited on the catalyst.

U.S.P. 2,494,561. Combination Process for the Hydrogenation of Carbon Monoxide and the Production of Ammonia. L. C. Kemp Jr. to The Texas Company.

An iron catalyst employed for and reduced in activity by the synthesis of ammonia from nitrogen and hydrogen is subsequently employed for converting

a CO/H_2 mixture to hydrocarbons. The catalyst is then regenerated to its original activity and re-used for the ammonia synthesis.

U.S.P. 2,495,278. Dehydrogenation of Alkyl Aromatic Compounds. J. E. Nickels to Koppers Company, Inc.

Vapors of alkyl aromatic hydrocarbons with at least 2 C atoms in the alkyl group are mixed with a large excess of steam. The steam-vapor mixture is passed at 500-700°C. through a bauxite catalyst containing a minor proportion of alkali metal carbonate. Dehydrogenation is effected, e.g. the production of styrene from ethylbenzene.

U.S.P. 2,496,253. Production of Xylenes. G. Purcell and D. C. Hausch to Shell Development Company.

Details are claimed of a process for the production by dehydrogenation of xylene from a hydrocarbon mixture consisting of a predominant proportion of dimethylcyclohexane and of open chain paraffins with similar volatility to the dimethylcyclohexane and to a xylene of similar C skeleton.

U.S.P. 2,496,265. Hydrocarbon Synthesis Process. J. P. Bilisoly to Standard Oil Development Company.

Carbon monoxide and H_2 are reacted in the presence of a fluidized catalyst of the VIII group of the periodic system and a difficultly reducible metal oxide promoter, both associated with a silica gel carrier. This catalytic mass is formed by a process claimed in detail. Normally liquid hydrocarbons are obtained.

U.S.P. 2,496,342. Method for Forming Synthesis Gas. B. G. Gillespie to Standard Oil Development Company.

Methane is contacted with CO_2-gas in the presence of a copper catalyst carried on activated carbon at an elevated temperature not exceeding 1350°F. A gaseous mixture is obtained containing H_2 and substantial amounts of CO in proportions suitable for the Fischer-Tropsch synthesis.

U.S.P. 2,496,343. Red-Iron Oxyde Type Fluid Catalyst for Hydrocarbon Synthesis. B. G. Gillespie to Standard Oil Development Company.

A CO/H_2 synthesis gas mixture is contacted at synthesis conditions with a fluidized mass of sintered, reduced, iron oxide particles obtained by incorporating into red-iron oxide powder a promotional amount of K_2CO_3, reducing the resulting composite including a sintering treatment in a hydrogen-containing atmosphere at 1600°F., and grinding the sintered product.

Oil Change Said Not Needed With Car's Use of Filter

No oil changes in a car is necessary, according to J. E. Housley, an Aluminum Company of America engineer, with the use of a filter called a "treater," being developed by company engineers, and said to eliminate nine-tenths of the wear to a motor from sludge. The filter employs a cartridge which contains highly activated alumina, obtained in the processing of aluminum ore. The

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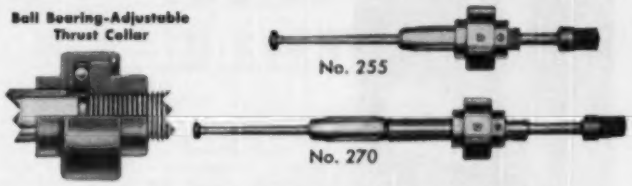

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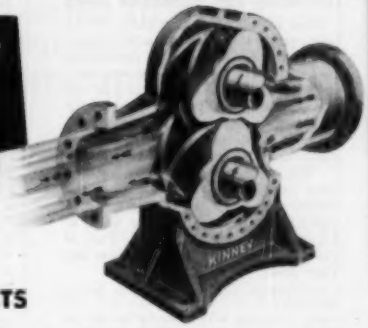

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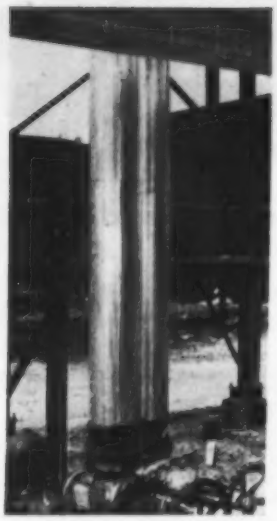

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alumina acts to sponge acids from the oil, it was explained.

The aluminum company has installed the filter in all of the cars in its power division, at claimed savings of $300 in the maintenance of each engine during 40,000 miles of driving.

LP-Gas Promotion Planned

A national promotional program presenting the LP-Gas industry, and sponsored by the Gas Appliance Manufacturers Association, the Liquefied Petroleum Gas Association, and the Natural Gasoline Association of America is underway. The project seeks to stimulate and assist sales, advertising and promotion of LP-gas promotion at the local level, consolidate gains made in recent years by the industry, and to expand national markets for LP-gas, LP-gas appliances and equipment. Participants are producers, distributors and dealers, manufacturers of handling and regulating equipment, tanks and cylinders, makers of LP-gas ranges, water heaters, heating equipment, refrigerators and other appliances.

Polytechnic Receives Grant

The Research Corporation of New York has made a grant of $5500 to Polytechnic Institute of Brooklyn in support of a $6800 research project for 1950-51 on the study of plate efficiency in distilling columns, under the direction of Ju Chin Chu, associate professor of chemical engineering. Two productoral fellowships for the project are available at the annual stipend of $2000.

Applications should be submitted promptly to Professor Donald F. Othmer, head of Chemical Engineering Department, Polytechnic Institute of Brooklyn.

Instrument Exhibit Slated

Scientific and industrial instruments and devices for measurement, inspection, testing and automatic control will be included in the fifth national instrument conference and exhibit to be held September 18-22 in Buffalo, N. Y., Memorial Auditorium. Technical sessions will be conducted also by The Instrument Society of America, American Institute of Physics, Industrial and Regulators Division of the American Society of Mechanical Engineers. Instruments and Measurements Committee of the American Institute of Electrical Engineers, and the National Telemetering Forum.

Socony Renews Five Grants

As part of its program for 20 fellowships in colleges and universities during 1950-51, Socony-Vacuum Oil Company, Inc. has renewed five $2000 fellowships to Brown University, University of Wisconsin, the University of Oklahoma, Iowa State College, and the University of Notre Dame. The total represents 19 renewals and one new fellowship.

Socony-Vacuum started the program three years ago in cooperation with two affiliates, Magnolia Petroleum Company and General Petroleum Corporation.

Cities Service Safety

Approximately 4000 employes of Cities Service Oil Company and Cities Service Pipe Line Company received safe worker cards last month in recognition of a total of more than 34,600 years of work without lost-time accidents. Each employe has averaged about nine years of safe work.

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BOOKS

Applied Chemistry Journal

Complete English translation of the **Journal of Applied Chemistry of the USSR** is available to American research laboratories and libraries. Subscribers to the English translation are said to receive complete translation of each 1950 issue within 7 weeks after its arrival in this country, and several months in advance of the abstract literature. Subscription to the entire Volume XXIII (1950) of the "Journal of Applied Chemistry of the USSR" in English translation is $80.

"The Journal of Applied Chemistry of the USSR" will be translated simultaneously with the "Journal of General Chemistry of the USSR," which Consultants Bureau is also publishing in English translation. The January, February, March, April and September (1949) issues of the latter journal are available in English. Subscribers to the English translation of the Journal of General Chemistry of the USSR will receive all 1949 issues by June 30, 1950, and all 1950 and subsequent issues within eight weeks after receipt of each issue in the United States. Annual subscription to the Journal of General Chemistry of the USSR in English translation is $95.

Brazil Fuel Shortage Solution

Large-scale exploration of several promising oil shale deposits in Brazil offers a partial solution to the fuel shortages which have hampered that country's industrial and economic development, according to the Bureau of Mines. Oil shales and other rocks from which oil can be retorted have been found in ten Brazilian states, but the chief development work has been done in the Tremembe-Taubate area deposits, which are in the Paraiba River Valley in the state of Sao Paulo. Other deposits possibly suitable for development are the Marahu or Marahui to shales in the state of Bahia, and the Iraty black shales, extending through the states of Sao Paulo, Parana, Santa Catarina, and Rio Grande do Sul.

Development of the oil shale deposits Tremembé-Taubaté has been carried on by Companhia Nacional de Oleos Mineraes under control of the Brazilian government.

For a copy of **Oil Shale in Brazil**, by A. J. Kraemer, Bureau refinery engineer, write The Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh 13.

Safety Directory for 1950-51

The entire field of safety, fire protection and control, hygiene, first-aid and sanitation is covered in **Best's Safety Directory for 1950-51**, which is available from Alfred M. Best Company's Safety Engineering Division. One feature of the 511-page directory is its indexing and subject grouping system. Typical sections are arm and hand, body and leg, eye and face, fire, etc.

A copy may be obtained by writing Alfred M. Best Company, 75 Fulton St., New York 7, or branch offices in Atlanta, Boston, Chattanooga, Chicago, Cincinnati, Dallas and Los Angeles. Price $5.00 with lower rate for quantities.

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Books

Aromatic Hydrocarbons

ASTM standards on benzene, toulene, xylene, solvent naphtha is a compilation sponsored by ASTM committee D-16 on industrial aromatic hydrocarbons. Included are the 21 ASTM specifications and test methods covering various types of industrial hydrocarbons. Test methods cover acidity, acid wash color, copper corrosion, distillation, paraffins, color and hydrogen sulfide and sulfur dioxide content, and specific gravity of industrial aromatic hydrocarbons. Also given are the solidifying point of benzene, and thiophene in benzene. Specifications cover industrial 90, nitration and industrial grade benzene; refined, crude light and crude heavy solvent naphtha; nitration and industrial grade toluene; nitration and industrial grade, five-degree and ten-degree xylene.

For copies write American Society for Testing Material, 1916 Race Street, Philadelphia 3, Pa. Price $1.00.

Petroleum, Natural Gas Studies

A summary of the technologic studies and research on petroleum and natural gas carried on by the Bureau of Mines, U. S. Department of the Interior, during fiscal year 1949 is available in Information Circular 7551. Based upon material prepared by the scientific staffs of the Bureau's field stations, the report includes data on the production of oil and gas, the transportation of gas, the chemistry and refining of petroleum, the thermo-dynamic properties of hydrocarbons, and the recovery, conservation and uses of helium. The report states that the bureau's functions in the field of petroleum and natural gas are essentially the same in peace and war. In 1945, the emphasis was still on war needs such as supplying information regarding the manufacture of aviation gasoline and jet-propulsion fuels; in 1946, on distributing the technical results of wartime research; in 1947, on broadening the research program to meet expanding peacetime needs; and in 1948, on giving closer attention to technical detail and balancing industry's need for technical knowledge with governmental research possibilities. The report was prepared by R. A. Cattell, branch chief, and others.

For a copy of **Report of Petroleum and Natural-Gas Branch, Fiscal Year 1949** write the Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh 13. Free.

Air Conditioning Guide

The 1950 28th edition of the **Heating, Ventilating and Air Conditioning Guide**, issued by the American Society of Heating and Ventilating Engineers, contains a 1024-page technical data section and a 396-page catalog of the latest manufacturers' products. Fifty chapters are divided into groups of fundamentals, human reactions, heating and cooling loads, combustion and consumption of fuels systems and equipment, special systems, instruments and codes. A cross-index is also given.

For a copy write American Society of Heating and Ventilating Engineers, Office of the Secretary, 51 Madison Avenue, New York 10. Price, $7.50.

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NEW EQUIPMENT and Manufacturers' Literature

For copies of manufacturers' literature or more information about products described on these pages write to the address shown, using the number shown for each item desired.

Jeep Fire Truck (Item 189)

A low cost jeep fire truck has been developed by Ansul Chemical Company and carries 340 pounds of dry chemical for extinguishing large area flammable liquid, gas and electrical fires. A 300-pound tank of dry chemical is provided for combating large fires. On Model 340-J2, two 50-foot hose lines are attached to the dry chemical tank and may be operated together or singly. They are coiled in steel cabinets for protection against weather. Two Ansul 20 extinguishers mounted on the hood are available for small fires. The Model 340-J1, which can carry a maximum of four riders, has one hose line. Truck's curb weight is 3200 pounds. Additional fire-fighting or rescue equipment may be added. Dry chemical equipment is mounted on a standard universal jeep (four wheel drive) Model CJ-3A which has six speeds forward, two in reverse. Top speed is 60 miles an hour. Standard tire size is 600 x 16 4-ply with non-directional tread with a turning radius of 18 feet.

For further information write Ansul Chemical Company, Marinette, Wis.

Ion Exchange Bed (Item 190)

A new concept in deionization, the use of a special dyed mixture of Amberlite resins which change color as the bed becomes exhausted, has been developed by the Resinous Products Division of Rohm & Haas Company. The Monobed technique, which delivers water free of ionic impurities by a single passage through the bed of exchangers, provides complete deionization, yielding a product with a mineral content of less than one part per million from ordinary faucet water. Addition of the new indicating feature affords a simple means of checking qualitatively the exhaustion point of the bed. The operator can watch the bed change color as exhaustion advances. Without instrumentation he can observe when to regenerate or replace the resins. Determining the end-point depends in operation on the combined performance of an anion exchanger and a cation exchanger, which together prevent leakage from the bed and result in a sharp, rather than a gradual separation of colors.

For further information write the Resinous Products Division, Rohm & Haas Company, Philadelphia.

Arc Welding (Item 191)

Distinctive features, operating data, specifications and other data are given in Air Reduction Sales Company's arc welding machine catalog, the fourth of a projected series of ten. The general catalog is divided in two parts, the first dealing with a.c. arc welders, the second with d.c. machines.

For a copy write Air Reduction Sales 60 East 42nd Street, New York 17.

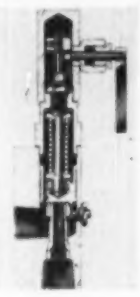
Flow Gauge (Item 192)

Design, operation and installation of Fischer & Porter Company's Magna-Sight flow gauge is explained in Catalog 96. Specifications including dimensions, flow rate and pressure data, materials of construction, and flow scale, are given for both flanged or screwed pipe connections.

For a copy write Fischer & Porter Company, Hatboro, Pa.

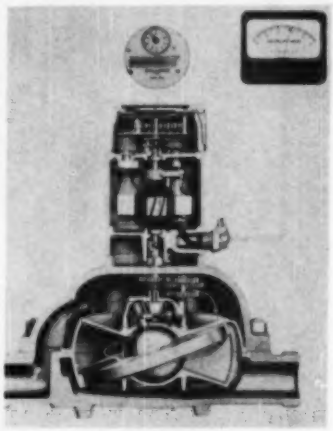
Bar Stock Valve (Item 193)

Farris Engineering Corporation announces the addition of a new, extra rugged, compact, forged bar stock valve to its line of safety-relief valves. Known as Type 2745, the new valve is supplied in stainless steel, steel and brass, with a choice of orifice sizes, for pressures up to 10,000 pounds. According to tests conducted by the company, it has a coefficient of discharge equal to that of a nozzle discharging direct to atmosphere. Features of the new valve include a new lower blowdown ring, self-aligning flat disc and long spring for close adjustment. The nozzle, perfectly aligned for concentricity, is secured by a nozzle retaining nut. Full capacity is obtained through high disclift, developed by utilizing the full force of the nozzle flow. All parts are machined from forged bar stock. Nozzles and discs are Type 316 stainless steel. Farris Engineering Corporation states that Type 2745 was engineered to give high capacity service at low cost.



For further information write Farris Engineering Corporation, 536 Commercial Avenue, Palisades Park, N. J.

Corrosive Liquid Controls (Item 194)



Measurement in The Hays Corporation Veriflow meter, for indicating corrosive liquid flow, is volumetric. Each complete movement of the measuring piston displaces a fixed volume of liquid. The rate of flow is indicated without interruption and every gallon is totaled on the meter's register. Flow control is through the Veritrol which is a Veriflow meter plus automatic control. The output of the meter generator is measured by a contact-making relay which, through its contacts and reversing relays, operates a motor which, in turn, positions a control valve. Complete information is contained in Bulletin 48-766.

For a copy write The Hays Corporation, Michigan City, Ind.

Pressure Testing Intensifier (Item 195)

A simple setup for static pressure testing of boilers, piping systems, compressor cylinders and similar pressure vessels is made possible by a new, air operated hydraulic pressure generating device. Developing up to 23,000 psi., this device, the Cooper-Bessemer "Intensifier" is suitable also for many types of laboratory destruction tests where extremely high pressures are involved.

It is exceptionally compact in design, weighing 80 pounds and is mounted on a two-wheel rubber tired under-carriage for easy portability to any testing job. The operation of the unit requires only the connecting of the Intensifier to any ordinary compressed air line. Oil is drawn from the unit's built-in supply reservoir. Variable static hydraulic pressures are preset by a simple turn of the

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Condenser efficiency restored-

by Dowell Service

The water sides of fifteen tube and shell condensers in a West Texas refinery were almost plugged by heavy scale deposits. Dowell was called in to clean them. After a six hour soaking with specially selected Dowell solvents, they were flushed out and returned to service. Following this chemical cleaning, gasoline left the condensers 20°F cooler than after a previous mechanical cleaning. *The improvement in operating economy paid for the job in 12½ days!*

When you specify Dowell Chemical Scale Removal Service for your cleaning job, you get fast, convenient service. No scaffolding or dismantling of the equipment is required. Special solvents designed to dissolve or disintegrate the insulating scale are pumped in and out through existing connections. Costly down time is minimized.

Experienced Dowell engineers do the job. They bring the essential equipment — truck-mounted tanks, pumps, heaters, and chemical proportioners — to make possible step by step control of the work. Call the nearest Dowell office for fast, practical and economical removal of scale and sludge from all types of heat exchange equipment, steam generators, water lines and water wells. Free cost estimates gladly given.

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SIDE ENTERING MIXER FOR OILMEN

Eastern side entering agitators are specially engineered for large tank installations. Material tending to settle during mixing is kept in motion by the propeller; bottom precipitation is thus prevented. Cast ribbed bases supporting motor and stuffing box insure rigid alignment — eliminate wear and leakage.

These heavy duty mixers are available with pressure stuffing box, twin rotary seal or mechanical rotary seal; also with outboard stuffing box which can be repacked without emptying tank. They're powered with motors rated from ¼ to 30 H.P., with rotating speeds from 400 to 1725 R.P.M.

WRITE FOR FULL DETAILS

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New Equipment

Intensifier's regulator valve that is equipped with a dial-type air pressure gauge. Discharge pressures are visibly indicated on a large direct reading dial gauge. Any static pressure up to 23,000 psi. can be quickly built up by using air line pressures up to 90 psi.

For bulletin write The Cooper-Bessemer Corporation, Mount Vernon, Ohio.

Corrosion-Resistant Alloys (Item 196)

A new edition of "Hastelloy High-Strength, Nickel-Base, Corrosion-Resistant Alloys," published by Haynes Stellite Division, Union Carbide and Carbon Corporation, tells what they are, how they can be fabricated, and also how they can be used to combat severe corrosion. Tables show the resistance of the Hastelloy alloys to six common corrosive media. Graphs compare the properties of Hastelloy alloys with those of four other common construction materials.

Also included are descriptions and suggested uses of the various forms of the Hastelloy alloys.

For copies write Haynes Stellite Division, Union Carbide and Carbon Corporation, Kokomo, Ind.

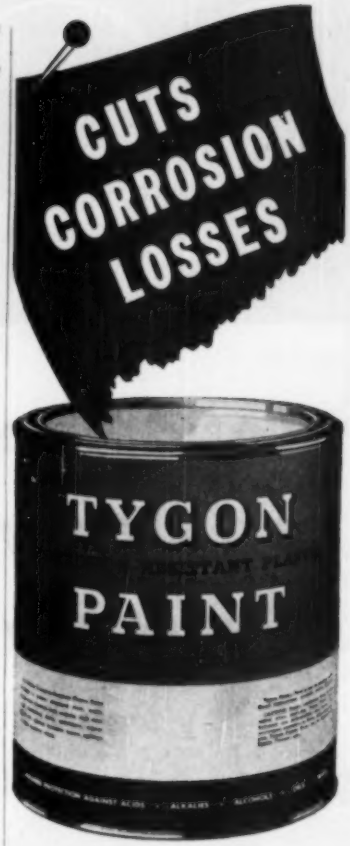
Motor Selection (Item 197)

"How to Select Large Motors for Pumping Service in the Oil Industry" is the feature article in the oil industry number of the E-M Synchronizer No. 30. Other articles are on insulation requirements, safety of motor controls, electric power generation for oil field use, electric power generation in field processing plants and in compressor stations. Also described is the recently installed basin ozark pipe line.

For copies write Electric Machinery Manufacturing Company, Minneapolis 13, Minn.

Process Pumps (Item 198)

Open or closed impellers, mechanical seals or conventional packing are furnished with De Laval Steam Turbine Company's Type CP pumps designed for handling hot or cold clear liquids, viscous liquids, corrosive liquids, and liquids carrying suspended solids. To compensate for wear at the impeller face, the entire rotor can be adjusted axially by



TYGON plastic Paint protects metal, concrete and wood from attack by acids, alkalies, oils, fresh or salt water. Tough, flexible film resists impact. Non-contaminating to solutions.

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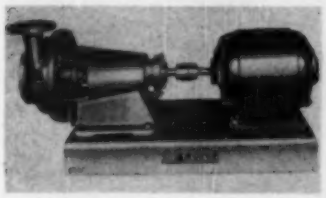

means of an external adjusting screw. Eductor vanes on back of the impeller reduce end thrust, relieve stuffing box pressure, and keep the back of the impeller clean when handling liquids with solids in suspension. Bearings are permanently lubricated. Parts are standardized so that only two sizes of shafts, shaft locknuts, bearings, bearing cartridges and pedestals are needed for the seven sizes.

For further information write De Laval Steam Turbine Company, Trenton 2, N. J.

Plate Fabrication (Item 199)

"Steel and Alloy Plate Fabrication," designed mainly for engineering personnel, offers a pictorial story of the fabrication of steel and alloy tanks and pressure vessels. Stainless steel, monel, nickel, copper, aluminum, Hastelloy and clad steels are among the corrosion resistant alloys described. Comprehensive charts give corrosion data.

For copies write Nooter Corporation, 1400 So. Second Street, St. Louis 4, Mo.

Extinguisher Decals (Item 200)

To help identify and locate the proper fire extinguisher in a hurry, The Meyercord Company has developed three new decal sets for positive selection of extinguishers for fires of: 1) wood, paper, rubbish; 2) electric, gas, chemical; and 3) of any origin except electrical. A large decal, 8 x 9 inches, is supplied for application to the wall above the fire extinguisher, and a smaller one, 1¾ x 2 inches, for the extinguisher itself. The new decals identify in three ways: by color code, by design, and by printed instructions naming proper use.

For further information write The Meyercord Company, 5323 W. Lake Street, Chicago 44.

Valve-Sizing Chart (Item 201)

Liquid and gas valve-sizing charts, covering the ranges 0.02 to 10,000 gpm. and 1 to 100,000 pounds per hour respectively, have been published by Fischer and Porter Company. The liquid valve-sizing chart takes into account the difference between pressure drop across the valve and across the valve ports alone, liquid viscosity and specific gravity in determining port area and valve size. The gas valve-sizing chart takes into account inlet and outlet

DURASPUN
18-8 Cylinder Liners

• True diameters

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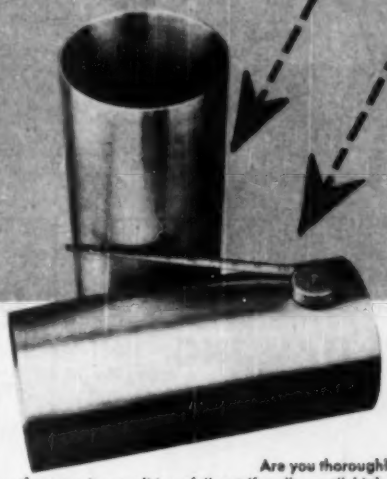
• Tough, close-grain metal



Are you thoroughly familiar with the superior qualities of "centrifugally cast" high alloys... such as these cylinder liners, for example?

Centrifugally cast metal is exceptionally uniform, close-grained and strong. It is free of pits and pockets. It is capable of passing very rigid tests. And the practical advantage is that as long as there is a central circular hole, almost any outside shape can be cast. Some of our customers want their castings centrifugal even though considerable boring and other machining is necessary to finish the piece.

We recommend our centrifugal casting service if your requirements call for the characteristics outlined above. Our high alloy foundry is modern in every respect and staffed by metallurgists and foundrymen of many years' experience with both centrifugal and static castings.

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absolute pressures, gas specific gravity and temperature.

For copies write Fischer & Porter Company, Department 7007, Hatboro, Pa.

Fuel Oil Treatment (Item 202)

E. F. Drew & Company, Inc., has announced a technical folder on fuel oil treatment and sludge removing. Described are means of preventing or correcting unsatisfactory conditions in the storing, handling, pumping, heating and burning of industrial fuel oil.

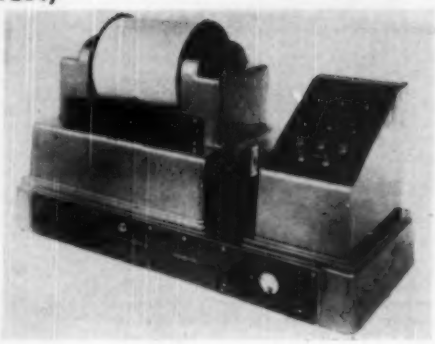
For copies write Power Chemicals Division, E. F. Drew & Company, Inc., 15 East 26th Street, New York 10.

Castings (Item 203)

A catalog, "Bronze and Copper Bearings and Castings" has been released by National Bearing Division of American Brake Shoe Company and contains pictures and charts, along with description of physical properties and comparative specifications for 27 different bronze alloys and five aluminum and manganese bronzes. Also included is an outline of the many applications of bronze. Sizes and weights of rough and machined "Tiger" bronze bars are tabulated. Babbitt metals, their descriptions and uses, are also discussed with various physical properties charted.

For a copy write National Bearing Division, American Brake Shoe Company, 4930 Manchester Avenue, St. Louis 10.

Spectrophotometer (Item 204)



A double beam infrared spectrophotometer with a wider range of operating variables than earlier commercial models is manufactured by The Perkin-Elmer Corporation. It records directly in percent transmission against a linear wavelength scale on large charts. The new instrument's resolution is up to the limitations imposed by the Raleigh criterion and Johnson noise. Its speed of scanning ranges from 3 minutes to 100 hours for the rock salt region. The wavelength drive speed can be suppressed automatically when desired. Time of response varies from a few seconds to more than a minute for full scale deflections. The over-all range of the instrument is from less than 2 microns to 15 microns in the rock salt region. Chart scales are uniform from 1 to 50 inches per micron by integral factors with the chart size about 32 by 11 inches.

For further information write The Perkin-Elmer Corporation, Glenbrook, Conn.

Heat Insulation (Item 205)

Carey tempchek, a new improved heat insulation in pipe covering and block form for temperatures to 1500° F., made by Philip Carey Manufacturing Company, consists of silicas, combined with asbestos fibers and bonding agents. The insulation forms tight joints, is non-irritating, easy to apply, and non-corrosive according to the firm. Recommendations are for insulating superheated steam equipment in high temperature, high-pressure power plants and for high temperature surfaces such as oil stills, ovens, boiler walls, breechings, furnaces and other equipment.

For further information write Philip Carey Manufacturing Company, Cincinnati 15.

Hydraulic Cylinders (Item 206)

A new line of air and hydraulic cylinders, known as the medium duty series, an-

Specializing In

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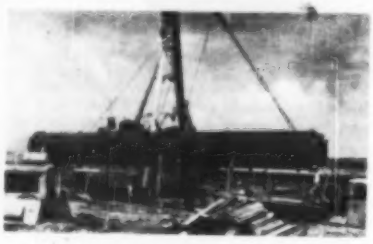

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A Complete Organization Serving the Major Industries Throughout the Southwest for 66 Years.
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Pump Packing Troubles

may mean costly shutdowns. Packing troubles ALWAYS mean higher operating costs. Have you tried Centrifugal Pumps which require NO packing? Most satisfactory for pumping acid and other corrosive liquids.

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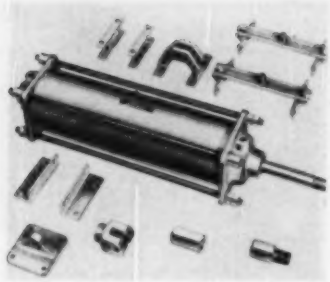


nounced by Ledeen Manufacturing Company, is an addition to the line of heavy duty and super duty cylinders being manufactured. Cylinders utilize tie-rod construction to give positive protection against leakage at joint of tube and head. Chevron packing is used to seal piston rod. Synthetic cups and automatic cushion are standard construction. Featured are completely standardized design, and head and rod attachments to provide for almost universal mounting requirements.

For further information or literature write Ledeen Manufacturing Company, 1600 So. San Pedro Street, Los Angeles 15, Calif.

Hydraulic Relief Valve (Item 207)

A new cartridge type of hydraulic relief valve, announced by the Hydraulics Division of Pantex Manufacturing Corporation, "meets or exceeds government standards as set up by Specification AN-V-1b for Army and Navy aeronautical use." Available for pressure settings ranging from 100 to 5000 psi., the new valve opens and closes within a 7 percent differential. Constant repeat accuracy is assured by the unique "in balance" design of the valve.

The unusual design "eliminates wire draw and provides high-volume flow at all pressures." The valve has been tested through temperature variations ranging from —65° to +160° F. with no more than a 5 percent change in operating characteristics.

For data sheets write the Hydraulics Division, Pantex Manufacturing Corporation, Pawtucket, R. I.

Infrared Analyzer (Item 208)

For measuring atmospheric contamination and precise process control, the Lira, an infrared analyzer of Mine Safety Appliances Company, is claimed to have an accuracy of one percent of full scale. Analysis "can be made in the range 100 to 1 parts per million." In some instances, concentrations are detectable to less than one ppm. Described in Bulletin DZ-4, the analyzer operates on the principle that most gases, vapors and liquids absorb infrared light in a portion of the spectrum which is specific for each product.

For a copy write Mine Safety Appliances Company, Braddock, Thomas and Meade Streets, Pittsburgh 8.

Steel Alloy Parts (Item 209)

The Carpenter Steel Company has developed new standard fastenings for use in the manufacture of chemicals, petroleum products, explosives, pharmaceuticals, which are claimed to have eight times the resistance of Type 316 and lead. Expected equipment life is four years for dye manufacturing heat exchanger coils using sulfuric acid solutions 1 to 105 percent. Applications include recirculating acid pump tank; electroplating copper, zinc; and pickling tank.

New Equipment

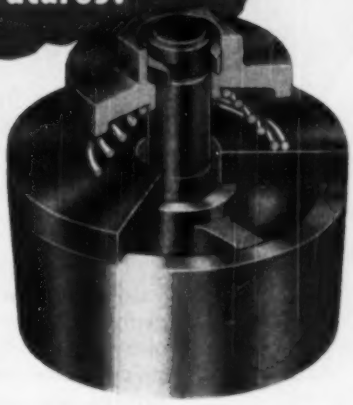
For further information write The Carpenter Steel Company, Reading, Pa.

Tank Stopper (Item 210)

Manufactured of neoprene, magnesium, brass and aluminum, Industrial Products

American Iron Reciprocating Pump Valves are

HIGHLY RESISTANT to Corrosion and High Temperatures!



NO threaded connections to corrode in this American Iron Valve designed for reciprocating pumps in refinery and industrial service!

NO steel to corrode! Constructed entirely of bronze and phenolic, for operating temperatures up to 300°, and pressures up to 750 psi.* Manufactured for all standard reciprocating pumps using replaceable valves.

EACH PART HIGHLY EFFICIENT!

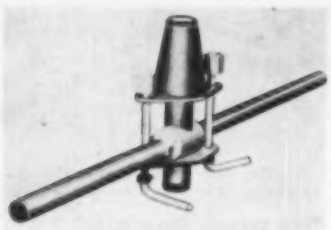
1. Hard, bronze alloy 3-web seat is cast with center guide as integral part.
2. Phenolic valve plate is highly resistant to both chemical action and high temperatures.
3. Conical valve spring offers only 6 to 8 lbs. resistance; compresses to ⅛-in. for greater valve lift in all pumps.
4. Valve and spring retainer is recessed to prevent damage to conical spring when valve plate is fully opened.
5. Easily assembled by use of retainer keeper. There are NO threaded connections.

*For higher temperatures up to 950°F. we recommend our all-stainless steel valve and seat of the same design.

AMERICAN IRON & MACHINE WORKS CO. OKLAHOMA CITY U.S.A.

AMERICAN IRON & MACHINE WORKS CO.
Oklahoma City, Okla.—Box 1177—Phone L. D. 518
District Office: Houston, Texas
Export Office: 11 West 42nd St., New York City

New Equipment



Company's new tank stopper is designed as an unloading device for emergency use on tank cars containing petroleum products and other liquids. Length including handles is 60 inches, with height 16¼ inches. Weight is 10 pounds. Contents may be unloaded through the device if desired, thereby eliminating the necessity of unloading from overhead.

For further information write Industrial Products Company, 3030 N. Fourth Street, Philadelphia 33.

Potentiometer (Item 211)

New model P-2 precision electronic potentiometer, Southwestern Industrial Electronic Company, is available for making precise potential measurements on high impedance electro-chemical cells or electronic tubes and circuits. The instrument is suitable for the measurement of potentials from zero to three volts in three ranges. Current flow in the measured circuit is less than 10^{-11} amperes, making the instrument fully suitable for use with glass electrodes. A built-in standard cell, combined with a 0.1 percent potentiometer and dual range dial, provides an accuracy of plus or minus (one millivolt plus 0.1 percent). The instrument is suited for precise Ph measurements, having a comparative accuracy of 0.05 Ph units.

For further information write Southwestern Industrial Electronic Company, 2831 Post Oak Road, Houston 19.

Pressure Controller (Item 212)

Increased accuracy in the control of diaphragm motor valves is offered through the use of the No. 1500 pilot, a pressure controller described in Bulletin 150 of McAlear Manufacturing Company. Other features include an indicator and calibrated scale showing set pressure, adjustment of set pressure and throttling range without use of tools, change from direct to reverse action without disturbing pressure connections and without tools. Hysteresis is said to be almost entirely eliminated and a newly-developed linkage of stainless steel transmits reflections of the helix with virtually no error due to friction or play.

For a copy write McAlear Manufacturing Company, 1901 South Western Avenue, Chicago.

Flow Interlock (Item 213)

A new control device which responds to a flow of cold water to open or close an electrical contact has been announced by General Electric Company's control divisions. Called a flow interlock, the device measures approximately 2½ x 3 x 7 inches. It closes a contact when a flow of water exceeds a preset amount and opens it when the flow falls below the preset amount. Thus the device actually acts as a fuse in a circuit which depends upon water cooling for protection. It can be used in hot water heaters, welding units, kitchen waste units, transformer cooling, induction heating, television luminaries, water-cooled dynamometers. Designed to operate for the amount of flow independent of pressure, the interlock is intended only for cold-water ap-

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Twenty-one years' experience providing a broad corrosion prevention service to the petroleum industry has brought NATASCO outstanding recognition in this field. This service is low cost insurance against corrosion damage. Our years of experience, plus carefully controlled manufacture of coatings, close supervision of surface preparation of tankage and application of the proper NATASCO products enable us to provide a guarantee on each completed job.
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PROTECTS TANKS AGAINST CORROSION
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P. O. BOX 7310
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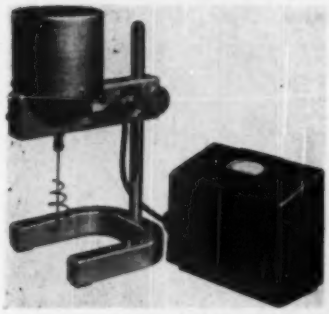
Lease Tank Service—West Texas Area:
Williams Construction Company
Odessa, Texas
California Representative:
Coast Contractors, Ltd.
4636 E. Slauson, Maywood, Cal.

plications. Electrical rating is 10 amps. at 125 volts, 5 at 250, and 3 at 460, all a.c. Maximum line pressure is 125 psi.

Write General Electric Company, Schenectady 5, N. Y., for publication GEC-411.

Viscosimeter (Item 214)



Especially designed for the measurement of thixotropic, gel or polymerizing substances, the potentiometric viscosimeter, an all electrical device, is introduced by Emil Greiner Company to eliminate the use of complicated mechanical clutches and linkages. It is easily adaptable for laboratory research or continuous plant operation and can be used with potentiometric recording devices. When used for gel-time studies, the new all electrical viscosimeter provides automatic stop at maximum deflection. There is an additional outlet for intermittant timer when used in studies of thixotropic or congealing substances. Adjustable ranges are icluded in construction.

For further information write Emil Greiner Company, 20-26 N. Moore Street, New York.

Total-Hardness Methods (Item 215)

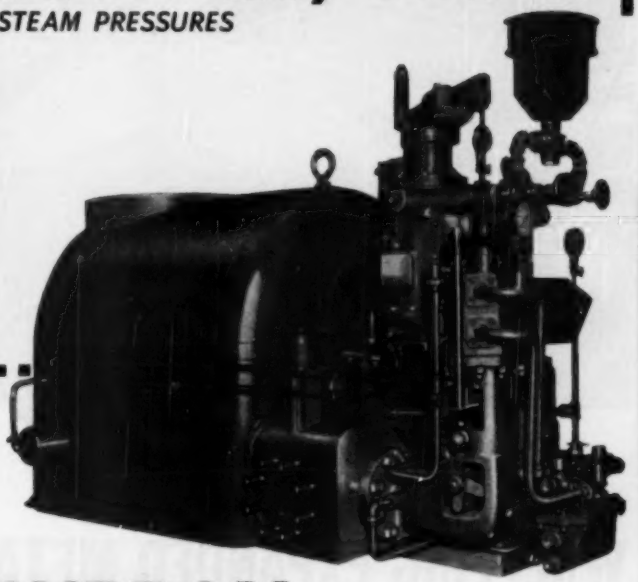
Hall Laboratories, Inc., has modified the Hagan total hardness test, discovered by Dr. Gerold Schwarzenbach and associates in Switzerland and describes it as a simple, direct titration with a distinct color change at the end point, so that the possibility of error due to subjective judgment is eliminated. The correct answer to less than 1 ppm. of calcium can be found in one minute. All equipment and reagents required for either the Hagan total hardness test or Hagan calcium test is being made available through Hagan Corporation, parent of Hall Laboratories and its associated firms, Calgon, Inc. and The Buromin Company.

For further information write Hall Laboratories, Inc., Pittsburgh.

Steel Castings (Item 216)

General engineering types of steel castings, classified according to tensile strength, are listed in a comprehensive chart distributed by the Steel Founders' Society of America. Included are engineering and design applications, current specifications, and typical specifications for especial tensile grade requirements.

ECONOMY
AT MODERATE INITIAL COST
100 to 4000
HORSE POWER RANGE
600 LB. GA., 750° F.
STEAM PRESSURES



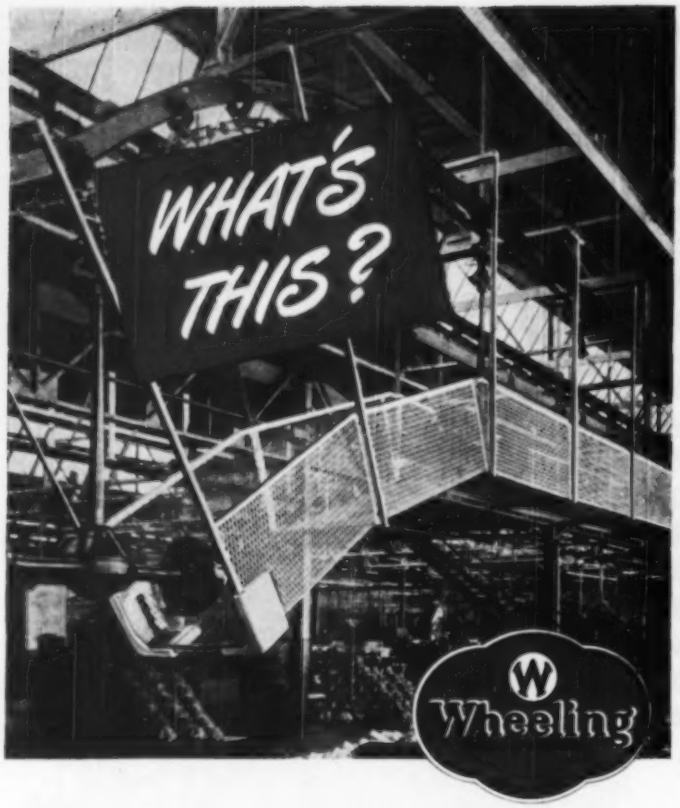
MURRAY
STEAM TURBINES
TYPE UV MULTISTAGE

The Type UV Multistage Turbine is available in from two to ten pressure stages making Multistage steam economy available at moderate initial cost. Horsepower range is from 100 to 4000, steam pressures up to 600# ga., 750° F., condensing or non-condensing. Several governors and accessories adapt UV Turbines to practically any mechanical drive within the capacity range.

Pictured is a 5 Stage UV Turbine developing 325 HP at 6200 RPM operating condensing. Turbine is equipped with variable speed oil relay governor, pressure lubrication and vacuum breaker, and is in use driving a centrifugal compressor for refrigeration.

Contact your Murray representative for prices and engineering information or write for Bulletin T-122.

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY



A conveyor guard of

WHEELING EXPANDED METAL

"Material of a thousand uses"

Wheeling Expanded Metal is a synonym for safety.

It safeguards people against accidents — makes extra strong machine guards, and barriers.

It safeguards property against intrusion without cutting off light and air. Use it for window and skylight guards, tool and stock room enclosures, partitions, tellers' cages.

It's a safety material underfoot, too—ideal for non-slip catwalks, stair treads and floors.

Expanded from steel sheets, it's "one-piece," not interlaced. Comes in a wide variety of weights and sizes. Write for complete data.

WHEELING CORRUGATING COMPANY

WHEELING, WEST VIRGINIA

Atlanta · Boston · Buffalo · Chicago · Cleveland
Columbus · Detroit · Kansas City · Louisville · Minneapolis
New Orleans · New York · Philadelphia · Richmond · St. Louis

New Equipment

The chart also contains data on specific yield point, elongation, reduction of area, hardness and impact evaluations, endurance limits, modulus of elasticity, machinability, and types of heat treatments.

For a copy write Steel Founders' Society of America, 920 Midland Building, Cleveland 15, Ohio.

Bosun's Chair (Item 217)

Painting, repairs and inspection of elevated work are facilitated by the new foot-operated "Bosun's Chair", manufactured by Safway Steel Products, Inc. Sitting on a bicycle-type saddle having two coil springs, the worker operates standard bicycle pedals to raise or lower the hoist. The chair consists of a rigid tubular steel cage moved by means of a winch which is equipped with three independent braking devices. The chair can be raised or lowered 25 feet per minute. Rated capacity is 625 pounds and weight is 75 pounds.

For further information write Safway Products, Inc., 6234 W. State Street, Milwaukee 13, Wis.

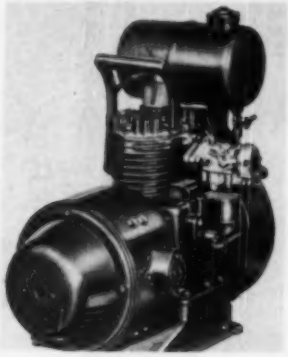
Mixing Device (Item 218)

Bryant Industrial Division of Affiliated Gas Equipment, Inc., is offering the "Flomixer," a proportional mixing device which permits developing the mixture pressures of manufactured gas, mixed gas or natural, or LP, still maintaining complete air-gas mixtures when using zero pressure gas. Mechanical advantages embodied include flange construction, inter-changeability of parts, simplicity of ratio adjustment, ease of changing inserts and making right and left hand installations without special parts. Data sheets 5C-lb. and 5C-1c give information on the method of selecting Flomixers for various types of burners.

For copies write Bryant Industrial Division, Affiliated Gas Equipment, Inc., 1020 London Road, Cleveland 10, Ohio.

Electric Plants (Item 219)

Marketing of two new Kohler electric plants to fill a wide variety of uses as a sole source of current in places not reached by central station service, to provide portable power for many kinds of jobs, or current for stand-by or emergency uses, is announced by Kohler Company. Engineered to meet the increasing demand for portable electric

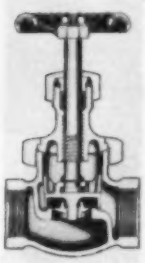


power, the 350-watt plant, shown here, equipped with carrying handles, weighs 70 pounds. A second addition is the 750-watt, 115-volt, a.c. model which operates 30, 25-watt lights at one time, household appliances, and various kinds of power tools with motors not exceeding ¼ h.p. The automatic model starts when any light, appliance or motor is turned and stops when all loads are turned off. These models are powered by Kohler-built one cylinder, air-cooled engines.

For further information write Kohler Company, Kohler, Wis.

LPG Valves (Item 220)

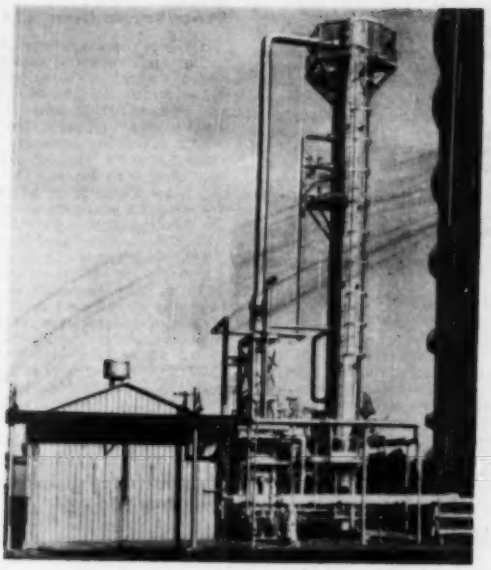
A new line of globe, angle, and check valves for liquefied petroleum gas service are announced by Crane Company. Tested and approved by Underwriters Laboratories, Inc., for use on LPG up to a maximum of 250 psi., all three types have screwed ends and are available in sizes ¼ to 2 inch. Embodied are composition disc cemented into the disc holder, and one-piece molded asbestos packing in a stuffing box of "very liberal dimensions." Recommendations are for hot or cold water, compressed air, gasoline, light oils, and other services requiring sturdy, tight valves within their pressure and temperature ranges.



For further information write Crane Company, 836 S. Michigan Ave., Chicago 5.

Electronic Control (Item 221)

An electronic control instrument, No. 077, sensitive to temperature changes of one-tenth of one degree has been developed by Minneapolis-Honeywell Regulator Company. The device is claimed to control industrial processing temperatures in which the temperature range is between 20 degrees below zero and 300 degrees above. Other features claimed are immunity to dust, vibration, and dampness. The model operates on the



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With Blaw-Knox, small projects receive the same engineering care as do large ones. Each problem is a matter for careful consideration by a separate department employing engineers of broad general experience. This group can handle a small job much more economically, because there is no overlapping or duplication of effort.

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OIL and GAS DEPARTMENT

CHEMICAL PLANTS DIVISION

BLAW-KNOX CONSTRUCTION CO.

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principle that resistance of a wire-wound sensing element varies in proportion to the temperature of the control medium. Electrical unbalance of the bridge is imposed on an electronic amplifier which amplifies and detects the direction of unbalance to operate either of two output relays, according to the direction of temperature change.

For further information write Minneapolis-Honeywell Regulator Company, 2753 Fourth Avenue South, Minneapolis.

Universal Rotameter (Item 222)

Schutte and Koerting Company's Bulletin 18-RB contains a description of the line of universal rotameters, utilizing the HCF, High Capacity Fluted, Rotameter tube. Also included are information on the operation of SK rotameters, the derivation of the rotameter formula, selection of rotameters and tabular material on SK rotameter capacities for liquids and gases. Sizes and dimensions are included with information on the application.

For a copy write Schutte and Koerting Company, 12th and Thompson Streets, Philadelphia 22, Att: Dept. M-A.

Reference Table (Item 223)

A linear conversion table, TDC-110, for handy reference by engineers who frequently wish to convert inches and fractions of inches into decimal parts of a foot has been printed by The Babcock & Wilcox Tube Company.

For a copy write The Babcock & Wilcox Tube Company, Beaver Falls, Pa.

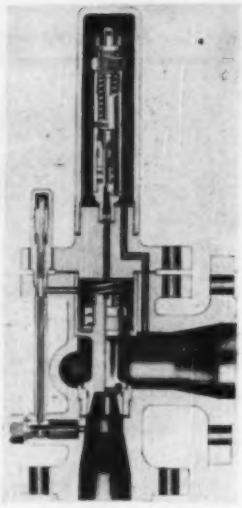
Relief Valves (Item 224)

Two relief valves, types A and B, featuring high relieving capacity and precision control of blowdown, are being manufactured by Garrett Oil Tools, Inc., and are available only through Sales Engineering Company, Inc. The valves, which utilize line pressure to open and close the main plunger, have bodies of cast steel with Inconel and Monel trim. They are available in all standard sizes for working pressures as specified. Type B, pictured here, provides precision in blowdown control and is recommended where accuracy is required in control of gases, liquids and vapors. It is designed for operating temperatures up to 750° F. Type A is designed principally for hydraulic services and is recommended for use on crude and product lines and systems where long blowdown is usually desirable. Replaceable seats are standard in Type B and optional in Type A.

For further information write Sales Engineering Company of Houston, Inc., City National Bank Building, Houston.

Electrostatic Precipitation (Item 225)

Electrostatic precipitation is described in Bulletin GEA-5212 of General Electric Company. Case histories of seven typical installations are explained along with the various methods of electrostatic precipitation and the electric equipment applicable to each method. This precipitation is used for air cleaning, gas cleaning and recovery, painting, deposition, orientation, and separation. It can collect cigarette-smoke particles as small as 1/100,000 of an inch in diameter, or deposit fibers as long as ¼ inch on an adhesive-coated cloth to make pile rugs.



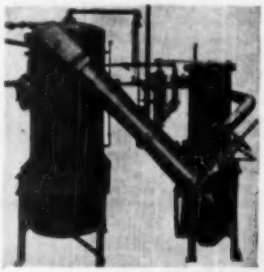
For further information write General Electric Company, Schenectady 5, N. Y.

Glass Orifice Plate (Item 226)

Precision Thermometer and Instrument Company has announced that Pyrex glass orifice plates now can be made "economically to extremely close tolerances maintaining sharp square

WHAT WILL SUMMER HOT WEATHER DO TO YOUR PROCESS

Croll-Reynolds CHILL-VACTORS frequently show a good profit over the total cost in extra production the first season, and they have many years of maintenance-free service. There are usually extra benefits in better quality and more uniform quality.



CHILL-VACTORS have many advantages, but are not perfect. In general, they are limited to temperatures above 32°F. They require more condenser water than mechanical refrigeration, but almost any natural water, including sea water, can be used. There are too many advantages to list here. The most important are:

- **Low cost**
- **Can be operated by low pressure steam**
- **No refrigerant except water**
- **No moving parts, noise or vibration**
- **Practically no operating supervision**
- **Some liquids or solids can be cooled direct without brine or other circulating fluid.**
- **Made in sizes from a few tons to 1,000 tons or more (1 ton = 12,000 B.T.U. per hour)**

Individual engineering study will be given without obligation to each inquiry. This also applies to any industrial vacuum requirement down to a few microns absolute pressure.

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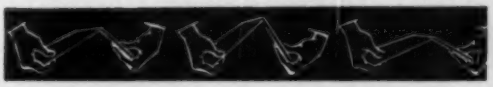
a lesson in simple mechanics . . .

Flex . . . metal . . . *like* . . . *this*



. . . and . . . something's . . .

bound . . . to . . . "*give*"

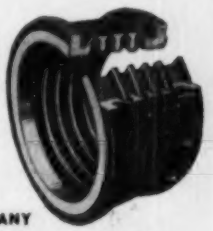
Do . . . *it* . . . *like* . . . *this* . . . and

. . . you . . . can . . . go . . . *on* . . .

***and* . . . *on* . . . *and* . . . *on* . . .**

Yes, it's a simple principle, one you know — and one you should keep in mind when buying an expansion joint. For this is, in fact, the principle underlying the all-curve construction of a Badger Directed Flexing Packless Corrugated Expansion Joint. As the illustration shows, the movement of the corrugated member of a Badger Joint is controlled and contained so that it *always follows a curved pattern* . . . no corners or angles where stresses can localize . . . no excessive strain . . . no chance of breakdown.

For economy's sake remember this important feature when you specify . . . remember that it's found *exclusively* in Badger Directed Flexing Packless Corrugated Expansion Joints.



Badger

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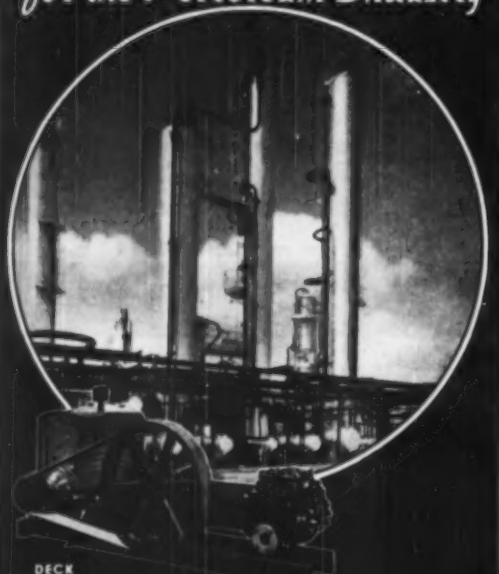
for the Petroleum Industry



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POT VALVE TYPE

CLOSE CLEARANCE

PISTON PACKED
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The McGowan Pump Division of the Leyman Mfg. Corp., since 1852, has been famous for accurate workmanship and dependable service. An experienced Engineering department is available for information on installations and requirements. Highly efficient and ruggedly constructed McGowan Pumps have the ability to stand up year in and year out under severe service conditions.

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The JOHN H. McGOWAN Co. Division

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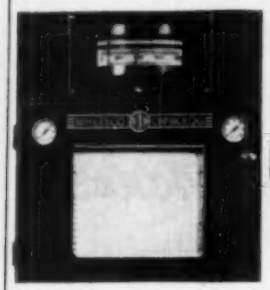

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. . . with the Wheelco Pneumatic Capacilog! *For safety*—where electric contactors or motors are a hazard—*for results*—where fixed position changes of fuel or medium are injurious to your product.

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Write for Bulletin C2, Wheelco Instruments Company, 701 W. Harrison Street, Chicago, Illinois.

See the Wheelco Pneumatic Capacilog Booth No. 232, Houston Industrial Exposition, May 10 to 14th.

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Asarco Lead Fittings . . . Elbows, Crosses, Tees, "Ys", (with plain ends, with flanges on, or for flanging in the field). Chemical and Antimonial.

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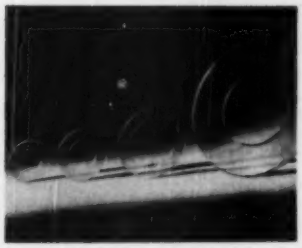
See Federated also for Lead Lined Pipe Lead Lined Fittings, Lead Lined Flanges

Federated Metals Division

AMERICAN SMELTING AND REFINING COMPANY, 120 BROADWAY, NEW YORK 5, N. Y.



edges where required." Both inside and outside dimensions are diamond-wheel ground. Glass orifice plates are available in various thicknesses from ¼ inch up and in sizes up to 16 inches od.

For further information write Precision Thermometer and Instrument Company, 1470 Brandywine Street, Philadelphia 30.

Rubber Lined Valve (Item 227)

R-S Products Corporation's 30-inch 50-pound cast iron valve, known as Type 709, is equipped with 125-pound flanges and a renewable one-piece rubber seat for positive shut-off. The valve is air bubble tight at 80 psi. and drip tight with water at 100 psi. It can be used in a temperature range from minus 20 to plus 200° F. The valve shaft moves with an oscillating motion. Special handwheel control has a fully enclosed gear reduction drive, easily adapted to automatic control. It is available in smaller or larger sizes, in all materials and for higher pressures.

For further information write R-S Products Corporation, Wayne Junction, Philadelphia 44.

Emergency Shower (Item 228)

Industrial Products Company's emergency shower is capable of spraying water from 29 gpm. at 30 pounds to 41 gallons at 60 pounds pressure. The shower is used as a counter-agent to acid exposure and for extinguishing clothing which has caught on fire. It is supplied from overhead through a one-inch diameter pipe, three feet long. It is controlled by a slow, self-closing valve operated by a chain attached to the floor. Shower head is eight inches in diameter, made of cast brass. The unit is furnished with ceiling flange, chain to floor, and floor flange.

For further information write Industrial Products Company, 3030 N. Fourth Street, Philadelphia 33.

Oscillating Grease Tester (Item 229)

In cooperation with Fafnir Bearing Company, Precision Scientific Company is offering an apparatus for testing lubricants to be used for anti-friction bearings undergoing small angle vibratory movements. In operation the test grease is applied to a simple lever which exerts thrust through a calibrated spring. An electric motor is started to oscillate the test bearings through an angle of 12 degrees, at a rate of 3450 reversals per minute under a thrust load of 550 pounds. The test is run continuously for 50 hours before the bearings are weighed and washed again. The test is comparative and the loss of

Here's how KEMP Dynamic Dryers remove moisture from air, gases or liquids, for as little as ¼c per mcf!

IF YOU think drying air, gases or liquids cost too much—find out how Kemp can save you money! Hundreds of Kemp Dynamic Dryers *control moisture at low cost* in plants all over the country. Operation is guaranteed to your specifications and the cost is surprisingly low. Many Kemp users report drying to *sub-zero* dew points for as little as ¼c *per mcf*—including all charges for labor, capital investment and materials!

FLEXIBLE DESIGN

Kemp Dynamic Dryers are versatile—offer *manual, semi-automatic* or *automatic* operation. Desiccant is especially selected and compounded for the type drying your problem calls for. With Kemp you can dry *air, gases* or *liquids, control humidity* in large or small areas, or *eliminate moisture* in materials. Gas, electric or steam regeneration is supplied as standard equipment.

SEND FOR INFORMATION

Whether your moisture control problem is special or standard, you'll find Kemp has a Dynamic Dryer especially designed to solve it. Find out how Kemp engineering can save you money. Get the facts. Bulletin D-27 contains specifications, technical data and full information. For your free copy, mail coupon today ▸

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Company .....
Address .....
City ..... Zone ..... State .....

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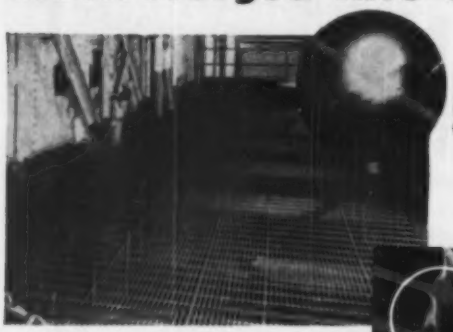
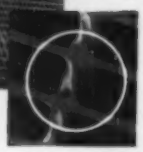


for **STRENGTH** *and* **SAFETY**



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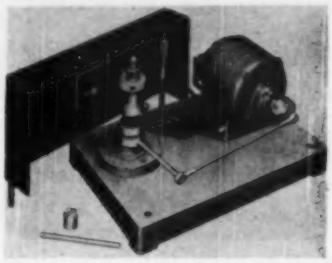
P. O. Box 2608 **Houston, Texas**

New Equipment



weight in milligrams indicates the suitability of the lubricant. To dampen noise and vibration, tester is rigidly mounted on a 1¼-inch steel plate base. Motor has ⅓ hp. and operates on 115 volts, 60 cycles. Over-all dimensions are 18 inches wide, 12 inches deep, and 12 inches high.

For further information write Precision Scientific Company, 3737 N. Cortland, Chicago 47.

Tank Float Switch (Item 230)

A simple and rugged level control for liquid at normal or high pressures is claimed for Clark Cooper Company's liquid level control tank float switch. The float ball travels up and down on the rod. By means of the adjustable stop the differential between make and break of the snap acting switch is from ½ inch up depending on size tank or chamber. The switch capacity is 10 amp. 125 volt. Models for low water cut-off for boilers with float in pressure casting housing and floats for right angle installations are also available. These controls are furnished to handle temperatures to 1000° F. and 1000 pounds pressure.

For further information write Clark Cooper Company, Inc., Palmyra, N. J.

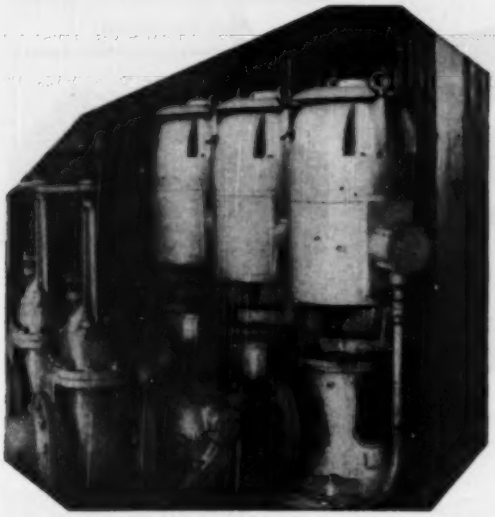
Heliwelding (Item 231)

Air Reduction Sales Company's booklet on Heliwelding, an inert-gas, shielded-arc welding process, explain the process and when to use it, under such section headings as "Heliwelding Joins the Hard-to-Weld Metals" and "How Current and Polarity Affect the Weld." Also included are sections on equipment for manual, semi-automatic and automatic operation; a new automatic filler-wire feeder, and power supply equipment.

For a copy write the nearest Airco sales office or Air Reduction Sales Company, 60 East 42nd Street, New York 17.

Plastic Pipe (Item 232)

"Carlon T," a new extruded pipe, developed by Carter Products Corporation, supplements the standard line of Carlon flexible pipe in much higher tensile and flexural strengths. Because of its semi-rigid characteristics, the pipe is recommended for over-land piping, jet well installations, for processing or exhaust systems handling highly corrosive fumes, gases, or vapors, and for use as a conduit to carry high voltage wiring in all types of electrical installations. Pipe sections are connected by means of plastic sleeves, which are first treated with a special cement and then slipped over the ends of the sections to be joined. Carlon "T" is guaranteed against rot, rust, and electrolytic corrosion. It is said not to form



GIVING YOU MORE

Good Features

Industrial Plant Superintendents, Water Works Engineers and Municipal Executives throughout the nation readily agree that Layne Well Water Systems and Layne Vertical Turbine Pumps have more good features than any other make. Such acceptance is due to Layne's extraordinarily fine designing, precision manufacturing and definitely superior installation methods. Furthermore there is a distinct advantage in owning water producing equipment built by an organization that is always ready and in a position to provide efficient repair and maintenance service when—and if needed. Hundreds of large water users of all kinds have found Layne equipment to be thoroughly dependable under every condition.

If you are in need of more water or want to consider the installation of a system of your own, the Layne organization is ready to offer experienced exploratory service, sound engineering advice and dependable construction plans. You incur no obligation in asking for this aid. For such service, catalogs, bulletins, etc., address

LAYNE & BOWLER, INC
GENERAL OFFICES, MEMPHIS 8, TENN.

LAYNE BUILDERS OF HIGH EFFICIENCY

WELL WATER SYSTEMS

ASSOCIATED COMPANIES: Layne-Arkansas Co., Stuttgart, Ark. • Layne-Atlantic Co., Norfolk, Va. • Layne-Central Co., Memphis, Tenn. • Layne-Northern Co., Mishawaka Ind. • Layne-Louisiana Co., Lake Charles, La. • Louisiana Well Co., Monroe, La. • Layne-New York Co., New York City • Layne-Northwest Co., Milwaukee, Wis. • Layne-Ohio Co., Columbus, Ohio • Layne-Pacific, Inc., Seattle, Washington • The Layne-Texas Co., Ltd., Houston, Texas • Layne-Western Co., Kansas City, Mo. • Layne-Minnesota Co., Minneapolis, Minn. • International Water Corporation, Pittsburgh, Pa. • International Water Supply, Ltd., London, Ont. • Layne-Hispano Americana, S. A., Mexico, D.F. • General Filter Company, Ames, Iowa

DON'T BE A LATE STARTER

1950 promises to be a tough, competitive year. One way you can get a fast start on profitable operation is to use standard Wilson-Dudgeon Tube Expanders to help solve your production or maintenance problems on tubular apparatus. Backed by 97 years of solid experience, Wilson-Dudgeon Tube Expanders will assure you of fast, easy, reliable tube rolling to cut down-time and increase production-time. Here are two of the profit-making Wilson-Dudgeon Tube Expanders:

Wilson-Dudgeon Model 38 Tube Expander for tubes 1" O.D., up. Self-feeding, parallel rolling and flaring action seats tubes quickly and solidly.

Wilson-Dudgeon Model 41 Tube Expander, parallel rolling, self-feeding with ball bearing thrust collar for rolling heat exchanger tubes ½" O.D. to 2½" O.D., into tube sheets to 6".

No matter what your tube expander problem, you can be sure of getting a Wilson-Dudgeon Tube Expander that will fit your specific application. Write us, giving full details or send for Bulletin 380.

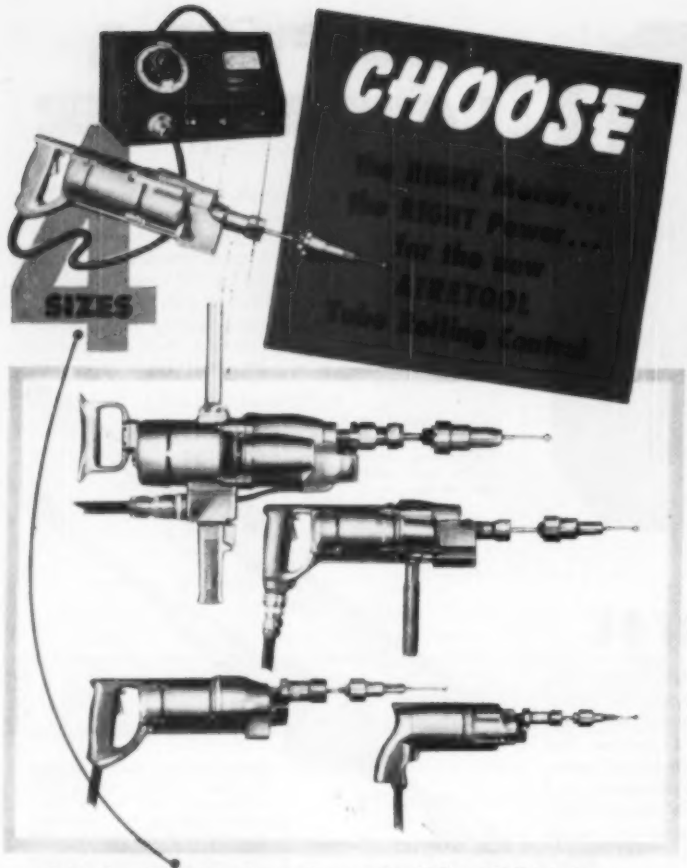
CUT FUEL COSTS *with* WILSON TUBE CLEANERS

Remember—1/16" of scale often wastes 10%, or more, in fuel. A Wilson Tube Cleaner makes short work of the toughest deposits . . . cleans both ferrous and non-ferrous straight or curved tubes. Air, steam, water or electrically driven cleaners available for tubes 3/8" I.D., to the largest ever cleaned. Write for Bulletin 47-A.

THOMAS C. WILSON, INC., 21-11 44th AVENUE, LONG ISLAND CITY 1, N. Y.

WILSON

WILSON TUBE CLEANERS
WILSON-DUDGEON TUBE EXPANDERS



Select from FOUR sizes for condenser tubes ¼" to 1½" O.D. Let our engineers help you select motor sizes best for your requirements!

One big reason why you can count on more accurate results with the Airetool tube rolling control is the wide choice of motor sizes which you have to power it.

There are, as shown, four electric motors which meet every known power or industrial requirement. Each is interchangeable with the control unit and in results surpasses the performance of air motors.

You will find this new-found tube rolling accuracy pays off in many ways . . . in longer tube life . . . reduced tube end corrosion . . . fewer tube failures . . . longer expander life and more accurate work. By selecting motors with the right speed and power you can deliver this greater accuracy and meet production or piece work schedules in less time.

For full information and our recommendations for the right motor that meets your requirements, write The Airetool Mfg. Co., 316 S. Center St., Springfield, Ohio.

WHY REPLACE HIGH PRICED STEEL PIPE?

Clean it with this AIRETOOL Wing Arm Head Type Cleaner

This cleaner has the power to remove severest coke, lime and scale deposits from lines and pipes. Reclaiming this expensive item is often an important saving. A swivel connection combines with the motor and head for cleaning straight pipe and a universal joint is used where pipes are bent.

THE AIRETOOL MANUFACTURING COMPANY
SPRINGFIELD, OHIO

BRANCH OFFICES:
New York, Philadelphia, Chicago, Houston, Tulsa, Baton Rouge
Representatives in Principal Cities.

There's an AIRETOOL Tube Cleaner and Tube Expander for every type of tubular construction.

New Equipment

a galvanic couple, and can be installed above or below frost level, as it is not damaged by freezing water.

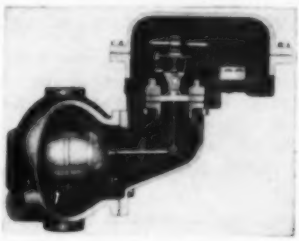
For further information write Carter Products Corporation, 10207 Meech Avenue, Cleveland 5, Ohio.

Control System (Item 233)

Lapp Insulator Company, Inc., has announced an accessory to its line of Pulsafeeder proportioning pumps (described in December PR, page 203)—the "Auto-Pneu-Matic" control system which provides for pneumatic instrument control of output. With the control, automatic volume change from zero displacement to full displacement is provided, automatic and in response to instrument air pressure change. The accessory makes possible systems in which pump output is made responsive to any measurable variable—flow, pH, temperature change, liquid level, pressure.

For further information write Lapp Insulator Company, Inc., Process Equipment Division, LeRoy, N. Y.

Electric Controller (Item 234)



McDonnell & Miller's new, explosion-proof float-operated electric controller for water tanks, receivers and other liquid storage systems is designed for use under conditions where a conventional type controller is not applicable. The No. 65 can be used to "make" or to "break" electrical circuits at either high or low levels, for example, controlling motors, signal lamps, and electrical elements.

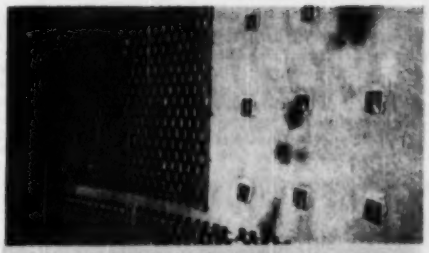
It has been Underwriters' tested and approved for use in class I, groups C and D. This float switch incorporates packless construction, heavy-duty mercury switch and totally enclosed wiring and terminals. It is furnished with a standard switch that breaks the circuit

SK-7 AND KS-4

TWO NEW REFRACTORY CASTABLES

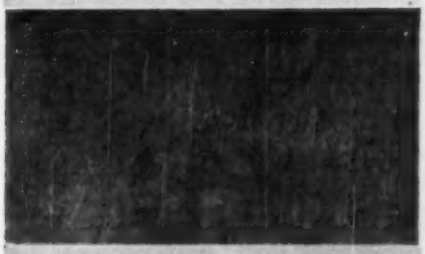
DESIGNED AND ENGINEERED FOR "GUN" APPLICATION

IN THE PETROLEUM FIELD



Application of SK-7 completed. Steel mesh attached to studs preparatory to shooting KAST-SET KS-4.

KAST-SET KS-4 being applied by means of a cement gun. Note steel mesh which anchors KAST-SET KS-4 and provides abrasion-resistant wearing surface for Catalytic Regenerator lining.



Interior of Catalytic Regenerator showing the completed lining with the KAST-SET KS-4 applied over the CASTABLE No. 20 SK-7.

CASTABLE No. 20 SK-7 — a lightweight insulating castable recommended for a service temperature of 1800° F., and KAST-SET KS-4 — a castable refractory with a top service temperature of 2750° F. were designed specifically, for cement gun application in the Petro-Chemical industry. This modern method of applying refractory castables greatly reduces labor costs. The A. P. Green Company, a leader in the development and manufacture of high quality castable refractories for normal pouring application, had the experience and engineering know-how necessary in producing these modern pneumatically applied castables.

Continued research, experimentation and improvement have resulted in the development of these gun-applicable refractory castables which afford the same trouble-free service obtained from A. P. Green mix and pour castables. They have gained wide acceptance in the petroleum industry and are specified by several large companies in that field. The outstanding advantages available through the use of SK-7 and KS-4 are:

1. Installation time and labor costs are reduced considerably, because these materials can be applied quickly.
2. Construction costs are held to a minimum as no forms are necessary.
3. These castables are adaptable to a variety of installations, particularly in places where normal pouring castables cannot be used.
4. The objectionable feature of many gun-applied materials (high rebound loss) has been corrected by the special compounding of these products.
5. Shooting a lining with SK-7 or KS-4 results in a finished installation having the balanced characteristics of a poured castable.

These materials were designed for use wherever castable refractories are required and in places where the use of normal pouring castables is impractical.

For detailed information concerning these castable refractories, write the Engineering Department of the A. P. Green Fire Brick Company — or call your local A. P. Green Distributor.

A. P. Green REFRACTORY PRODUCTS

A. P. GREEN FIRE BRICK COMPANY

Mexico, Missouri, U. S. A.

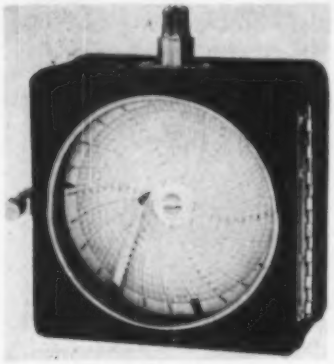
A. P. GREEN FIRE BRICK CO., Ltd. in Canada

Representatives in the Principal Cities of the World

with falling liquid level, but a reverse acting switch is available for completing the circuit with falling level.

For circular write McDonnell & Miller, Inc., Wrigley Building, Chicago 11.

Recorders (Item 235)



Minicorders, self-contained instruments for recording temperature, distant reading temperature, compound pressure and vacuum, electrical operation and combinations of these are announced by The Dickson Company in base, suspension, bracket or panel mountings. Charts are available for some 80 ranges. A guarantee to within 2 percent of scale range is claimed for the instruments which are individually calibrated and tested after final assembly. They are available in five sizes and two series. The mechanism is assembled to a heavy, lacquered aluminum dial. All parts are interchangeable. The four-inch diameter glass window is set in rubber.

For further information write The Dickson Company, 7416 Woodlawn Avenue, Chicago 19.

Fuel Vaporizer (Item 236)

A re-designed fuel vaporizer to power gas engines is described in a Black, Sivalls & Bryson, Inc., bulletin which gives operational data on this power source. Also explained is the process by which the vaporizer strips volatile fractions from pipeline or lease crude and makes them directly available to the engine carburetor. Basic crude requirements are also given. Illustrations include a detailed flow diagram and dimensional sketch of the 40-hp. fuel vaporizer. Specification and capacity tables cover the 20, 40, 110 and 300-hp. units now in production.

For a copy write Black, Sivalls & Bryson, Inc., 720 Delaware, Kansas City 6, Mo., referring by number to this PETROLEUM REFINER item.

Packings (Item 237)

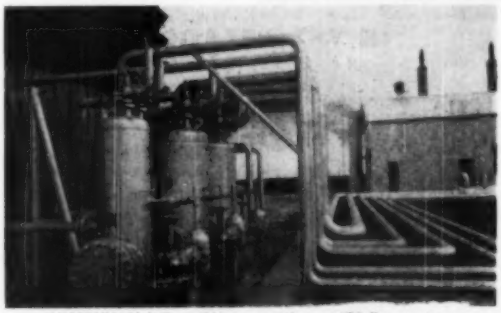
Palmetto (R) self-lubricating packings are discussed in Bulletin LP-10 issued by Greene, Tweed & Company. Included are principles of self-lubricating packing design, structure and performance as well as analysis of each individual packing from standpoint of application to specific services.

For a copy write Greene, Tweed & Company, North Wales, Pa., referring by number to this PETROLEUM REFINER item.

Welders Gas Mask (Item 238)

To protect welders on jobs where there are hazardous gases or smokes due to product residue or vaporization, Acme Protection Equipment Company has developed a special full vision gas mask,

MACHINED ENDS
Assure
Perfect Welding
FLOWLINE
STAINLESS STEEL WELDING FITTINGS . . .
for All Corrosion-Resisting Applications
It is possible to construct any stainless piping system with a minimum of equipment, using FLOWLINE fittings, simply by straight cutting of tubes, and plain butt welding. The ends of all FLOWLINE fittings are accurately machine tool cut—fittings of wall thickness over .083" are beveled to 37½° with approximately 1/16" straight face; those with wall thickness of .083" or lighter are cut straight, not beveled. Consequently, fitting time is minimized, and faster, uniformly sound welds are assured.
These fittings, manufactured in Stainless Types 304, 316, and 347, are available to match pipe and tubing of various wall thicknesses in sizes from ¼" through 12". They are annealed, cleaned, and passivated for maximum corrosion resistance.
The Most Complete Line of Stainless Steel Welding Fittings.
WELDING FITTINGS CORP.
NEW CASTLE, PENNSYLVANIA
Send for Bulletin S-310
World's Largest Manufacturer of Stainless Steel Welding Fittings



SUPERIOR-BUILT scrubbers operating at 600 lbs. pressure

SUPERIOR delivers
as planned and specified!

The above scrubbers were SUPERIOR-built for a West Texas repressuring plant. Other SUPERIOR refinery and gasoline plant equipment is found in many areas and it always meets vitally important specifications and code standards. FOR YOUR NEXT JOB, CALL SUPERIOR!

API-ASME AND ASME CODE CERTIFIED BY NATIONAL BOARD

ALSO FRACTIONATING TOWERS • HEAT EXCHANGERS • SCRUBBERS AND RETUBING OF HEAT EXCHANGERS

For Information or Estimates Call Amarillo 3-4395

SUPERIOR MANUFACTURING COMPANY
AMARILLO, TEXAS

known as Pur-a-weld, that can be used interchangeably with dust and fume canister or a compressed-air supply unit. Advantages include "greater vision, lenses in shades from 4 to 12; complete gas mask protection to reduce headaches, fatigue and other health hazards; easy fit and comfort; free-breathing; replaceable welding hood; interchangeable air supply."

For further information write Acme Protection Equipment Company, 3037 West Lake Street, Chicago 12.

Valve Selection Chart (Item 239)

A reducing valve selection chart is available from Klipfel Valves, Inc., a division of Hamilton-Thomas Corporation. Used in conjunction with reducing valve Bulletin 148, the chart also helps determine proper sizes of valves. The chart indicates which valves are suitable for dead-end service and which are not.

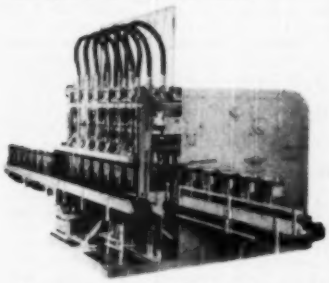
For a copy of chart and Bulletin 148 write Klipfel Valves, Inc., Hamilton, Ohio.

Grounding Reels (Item 240)

For use with the generation of static charges on fuel servicing equipment during the transfer of combustible fuels, Benjamin Reel Products, Inc., has developed the Series 200 portable grounding reels with cadmium plated and rustproof parts. The reel is useful in eliminating the possibility of fire or explosion because of discharge of sparks in the vicinity of inflammable fuels or vapors. The reel has a roller bearing arrangement and is equipped with 20 feet of 3/32-inch diameter phosphor bronze cable and a one-foot phosphor bronze pigtail to fasten to the ground connection. Ceiling or wall installation is possible.

For further information write Benjamin Reel Products, Inc., 10700-10710 Broadway, Cleveland 5, Ohio.

Filling Machine (Item 241)



Large quantity oil filling machine produced by Hope Machine Company is available for one gallon, two gallon, 2½ gallon and five gallon containers.

The company's "no container—no fill" device, embodied in this machine, "does not waste the product, and completely eliminates clean-up time."

For further information write The Hope Machine Company, 9400 State Road, Philadelphia 14.

Thermo-Setting Resin (Item 242)

The Electro Chemical Supply & Engineering Company announces a new type of thermo-setting resin used as an acid and alkali-proof cement or coating, called Duron, which is claimed to adhere without the use of a primer to concrete or metal, and is self-hardening at room temperature. Duron is not derived from phenolic or furfuryl alcohol resins. It is used in the manufacture of acid and alkali-proof cements for joining brick and tile, as a coating for concrete, steel, or wood, and as an impregnant for wood. Claimed is inertness to solvents, fats, oils, greases, alkalis, and acids.

For further information write Electro Chemical Supply & Engineerinng Company, 750 Broadstreet, Emmaus, Pa.

Power Costs (Item 243)

Worthington Pump and Machinery Corporation announces a new bulletin S-500-B-1-50 for quick determination of lowest power costs by visual inspection. Curves cover gas cost per 1000 cubic feet for dual fuel diesel, gas diesel, spark ignition gas, and oil cost per gallon for oil diesel. Costs are given in dollars per thousand kilowatt hours.

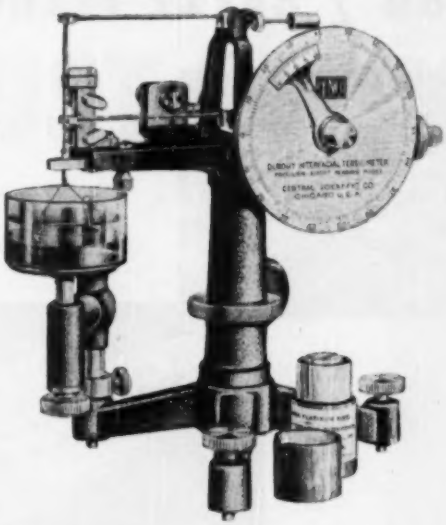
For copies write Engine Sales Division, Worthington Pump and Machinery Corporation, P. O. Box 953, Buffalo 5, N. Y.

Water Purity (Item 244)

F. J. Stokes Machine Company's water purity indicator claims quick and accurate testing of distilled and de-ionized water for purity. The indicator can be used for spot checkng or for permanent installation. Calibrated to zero for pure water and directly in terms of impurity content within the range of 0 to 30 ppm. of sodium chloride, this portable, heavy-

THE CENCO

DuNOUY INTERFACIAL TENSIOMETER



Interfacial and surface tension measurements are extremely important in pharmaceutical, biological and chemical researches, and the testing and control of transformer, lubricating, Diesel engine and vegetable oils. The Cenco instrument meets the requirements of ASTM Method D971-48T, Interfacial Tension of Oil Against Water by the Ring Method. Interfacial tensions between non-mixing liquids and surface tensions of liquids are measured easily and accurately.

No. 70540 CENCO-du NOUY INTERFACIAL TENSIOMETER, $302.50

Write for detailed information

CENTRAL SCIENTIFIC COMPANY

Scientific CENCO *Apparatus*

1700 IRVING PARK ROAD CHICAGO 13

NEW YORK BOSTON SAN FRANCISCO NEWARK LOS ANGELES TORONTO MONTREAL

duty tester can be plugged into a 110-volt, 60-cycle a.c. current source. Conductivity cells include glass dip cell for testing samples of distilled water in beakers, etc.; rubber dip cell for industrial use in testing purity of distilled water in storage tanks; and, threaded cell for permanent installation in tanks or piping systems.

For further information write F. J. Stokes Machine Company, 5000 Tabor Road, Philadelphia 20.

Control Panels (Item 245)

A booklet, explaining how The Hays Corporation's panels are made and where they are used describes operations of fabrication, layout, cutting, drilling, welding, fitting, painting, and wiring. Features like electric clocks, pressure gauges, transformers, name plates, push-button stations, signal lights are explained.

For Bulletin 773 write The Hays Corporation, Michigan City, Ind.

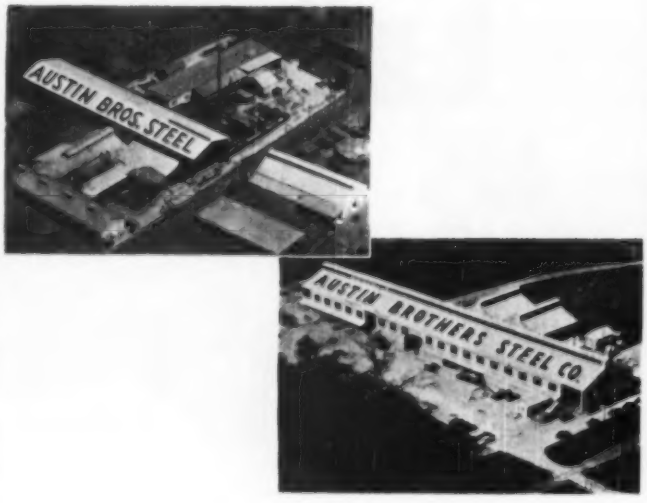
Gas-Liquid Separator (Item 246)

For critical pneumatic operations, Selas Corporation of America's new Liqui-Jector automatically removes water or water-oil emulsions from compressed air or gas lines. Phase separation and liquid ejection are accomplished by means of two controlled-porosity ceramic tubes, one water-repellent, the other water-permeable, but air-impervious.

For a copy write Selas Corporation of America, Philadelphia 34.

SERVING THE INDUSTRY

FROM 2 GREAT PLANTS



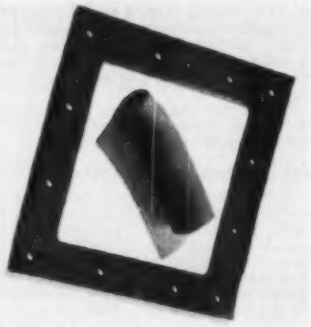
- *Structural Steel*
- *Reinforcing Steel*
- *Steel Warehouse Products*

AUSTIN BROS. STEEL CO.

GENERAL OFFICES
1815 COOMBS STREET
DALLAS 1, TEXAS

PLANTS
DALLAS, TEXAS
HOUSTON, TEXAS

Silicone Rubber Sponge (Item 247)



A new cohrlastic silicone rubber sponge, developed by Connecticut Hard Rubber Company from silicone rubber compounds permits production of the sponge with a density of 25 to 35 cubic inches per pound and resisting temperatures from —100° to +500° F. The cell size of this silicone rubber sponge is "more uniform than in earlier constructions and the material has improved tensile, elongation, tear strength and abrasion resistance." It is available from stock in sheets 1/16, ¼ and ¾ inches thick which may be died out for fairing strips and gasketing. It is also available in special extrusions and molded shapes on a custom basis.

For further information write Connecticut Hard Rubber Company, New Haven, Conn.

Cycle Controllers (Item 248)

Five models of Taylor Instrument Companies Flex-o-Time cycle controllers for applications requiring all-electrical or all-pneumatic or other combinations of each are described in Bulletin 98154. The instruments control any particular group of functions which may be required in the sequence of a manufacturing operation, according to a predetermined schedule and over a specifically timed period.

For a copy write Taylor Instrument Companies, Rochester 1, N. Y.

Hose Couplings (Item 249)

Bulletin No. 5 of Hose Accessories Company, describes the complete line of LE-HI suction and water hose couplings. Hose combination male hose nipples, brass and malleable suction and water hose coupling, hose pipe and adapters are also described. New items shown for the first time include the LE-HI 810 brass suction and water hose couplings which uses a hexagon swivel nut in place of the usual pin lug and LE-HI series 640 petroleum couplings, especially designed for handling bulk crude and petroleum as well as water.

For a copy write Hose Accessories Company, Lehigh and 17 Street, Philadelphia.

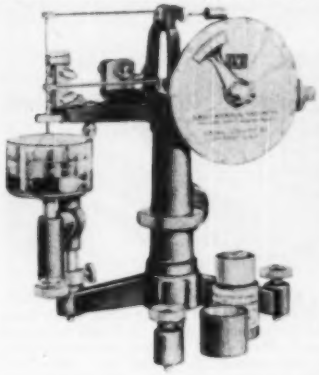
Refinery Products (Item 250)

"BS&B in the Refining Industry" features refinery products manufactured by Black, Sivalls & Bryson, Inc., and contains information on heaters, separators, gas scrubbers, dehydrators, safewalks, safety heads, relief valves, vent valves and flame arrestor combinations, as well as fuel vaporizors, storage tanks, chemical feeders, blow cases, mufflers, pipe

half soles and special fabrication.

For a copy write Black, Sivalls & Bryson, Inc., 720 Delaware, Kansas City 6, Mo.

Tension Oil Indicator (Item 251)



The No. 70540 Cenco duNouy Interfacial Tensiometer, developed by Central Scientific Company, helps determine interfacial tension of transformer, lubricating and diesel engine oil, according to the American Society of Testing Materials Designation D971-48-T. By showing when a change of oil is needed, the indicator helps avoid a burned out or damaged transformer as well as a needless and costly replacement of oil. Shipment can be made from stock.

For further information write Central Scientific Company, 1700 West Irving Park, Chicago 13.

Aluminum Paint Use (Item 252)

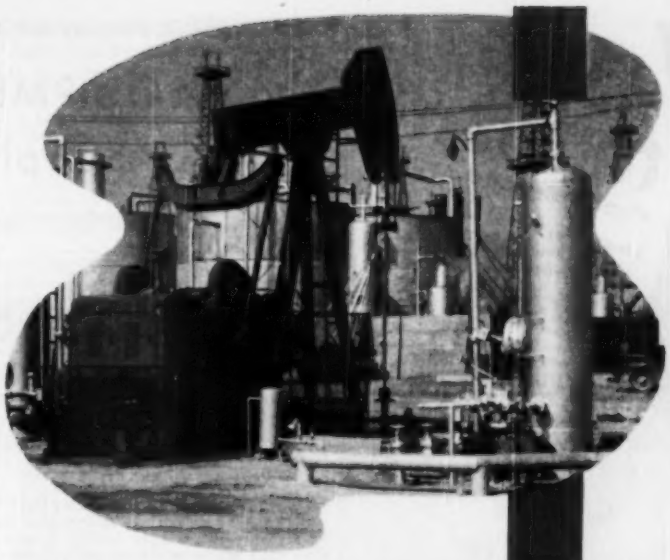
A brochure for industrial users of aluminum paint is offered to manufacturers by Aluminum Company of America. Emphasized are these uses of aluminum paint by business and industry: for metal, concrete and masonry and similar non-absorbent surfaces; for weather-exposed wood; and for interior heated surfaces and for decorative uses. Questions and answers and an aluminum paint coverage table are included.

For a copy write Aluminum Company of America, 661 Gulf Building, Pittsburgh 19.

Gas Purifiers (Item 253)

Newly developed Engelhard catalysts have resulted in the introduction of three expanded Deoxo processes by Baker and Company, Inc., for the catalytic purification, hydrogenation and oxidation of gases. The new model DM Deoxo purifier provides simultaneous catalytic combination of carbon monoxide plus hydrogen to carbon dioxide plus water vapor. Gas temperature must be maintained between 120° and 500° C. An oxygen content at least one-half the sum of the carbon monoxide and hydrogen must also be present. All three Deoxo purifiers are available in sizes ranging from 200 to 100,000 cfh.

For further information write Baker and Company, Inc., East Newark, N. J.



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STOPS RUST!

Add years to the useful life of tanks, pipes, derricks, fences, buildings, roofs and other metal properties by protecting them with RUST-OLEUM. It's a tough, pliable, *long-lasting* coating that seals metal against the ravages of rain, dampness, salty air, weathering and many destructive elements that attack your plant twenty-four hours a day.

Originally developed to combat the most damaging rusting conditions, RUST-OLEUM is widely used by petroleum plants from coast to coast. It has proved its capacity to meet every need of the industry for dependable, long-lasting anti-rust protection.

RUST-OLEUM can be applied without extensive preparation . . . even over surfaces that are already rusted. RUST-OLEUM spreads evenly . . . free of brush marks . . . and dries to a firm, elastic, rust-resistant film.

The time and labor saved in applying RUST-OLEUM mean substantial savings to you in maintenance costs. Yet RUST-OLEUM costs no more than most quality materials.

RUST-OLEUM is decorative, too! It's available in a large selection of colors including white and aluminum.

RUST-OLEUM is stocked and sold by leading industrial distributors in all principal cities in the United States and Canada. If you have a trouble-some rust problem, write for your copy of our catalog which contains full information and recommendations for use.

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anti-corrosive

strapping and seals

Send for free booklet and Strap Calculator containing information as to suitable type of metal to be used.

FREE

Handy calculator—one side tells you which strap to use for any given corrosive condition; the other side determines length and weight of strap required for any binding operation. SM1

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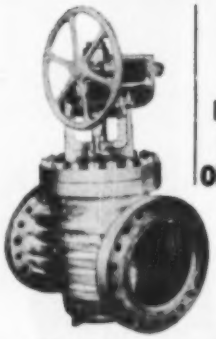
ALL PURPOSE STEEL VALVES



LIFTS TURNS and RE-SEATS IN ONE OPERATION

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DRY PLUG

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PRICED to compete with conventional plug-type valves. Interchangeable with American Standard Steel Wedge Gate Valves. Wrench-Operated; Direct Handwheel-Operated; Worm Gear-Operated; Sizes from 1" to 16". Write for our Catalog No. 600 and Price List. On request, we will be glad to quote on larger sizes above 16".

WEDGEPLUG VALVE CO., INC.

Department "R"

NEW ORLEANS 15, U. S. A.

About EQUIPMENT and SERVICE Suppliers

MOVES INTO NEW HOME—The Crosby Steam Gage & Valve Company's new home at Wrentham, Mass., which is pictured above, contains more than 100,000 square feet of floor space, and is newly equipped with machinery that "will enable us to meet the increased demand for Crosby safety and relief valves, pressure gages and precision instruments," officials said. A direct wire connects the Wrentham plant with the Boston sales office. Additional district sales offices are in New York, Chicago, Dallas and Los Angeles. The Ashton Valve Company, under the same ownership and management as Crosby, also has moved to this Wrentham plant, combining the manufacturing

Blaw-Knox Authorized to Use Mercury Cell Technique

Chemical Plants Division of Blaw-Knox Company has been authorized to construct chlorine and caustic soda plants using the Mathieson Chemical Corporation's stationary mercury cell technique. This process features the economical production of chlorine and caustic pure enough for direct use in the manufacture of viscous rayon. Blaw-Knox will be engineer-contractor for the design and erection of plants embodying the new technique, covering a wide range of capacities with a standardized small "packaged unit" specially designed for small producers and the foreign trade.

MM&M Executive Retires

At the annual stockholders' meeting of Manning, Maxwell & Moore, Inc., Robert R. Wason, president, announced that William J. Jarrett, controller and

ROLLING OFF—From a single oil drum factory in 1940 to eight widely scattered plants, producing some 25,000 barrels and drums and 35,000 steel pails every eight hours is the story of the expansion of Jones & Laughlin Steel Corporation and its subsidiary, J & L Steel Barrel Company. Early this year plant and equipment of the barrel company were increased 25 percent with the addition of American Can Company's steel pail and galvanized ware facilities at Toledo, Ohio and Atlanta, Ga. Photo above shows production line at Toledo plant where five-gallon necked-in closed-top oil drums are being capped and then spray-coated with black enamel. At present, J & L is consolidating steel pail and barrel producing facilities in a new plant at Kansas City, Kan. Another ACC steel pail line from Jersey City will also be combined with the present barrel producing plant at Bayonne, N. J. Other plants are at Cleveland, Ohio, Gretna, La., Philadelphia, and West Port Arthur, Texas. The Cleveland plant, formerly owned by Draper Manufacturing Company, one of the oldest steel container producers in the country, is said to be the largest single steel barrel plant in the business.

re-elected vice president, was to retire April 1 from active service with the company which he joined in 1906. John A. Flynn, who has been with the company 34 years, succeeds Jarrett as acting controller.

Harvard Graduate Joins Fischer & Porter Staff

Edmund D. Haigler has joined Fischer & Porter Company, Hatboro, Pa., to work on special customer engineering problems. A graduate of Harvard engineering and business schools, Haigler has formerly been with General Motors Corporation, E. I. du Pont de Nemours & Company, Inc., and The Foxboro Company where he was manager of the engineering department. He recently completed a two-year survey of the mining, milling and smelting industries. As member of a four-man instrument team he studied German industry for the U. S. in 1945. He is a member of ASME, AIME, and NSPE.

Haigler

Fluor Promotes Personnel In Three Sales Offices

The Fluor Corporation, Ltd., has promoted James G. DeFlon to the New York sales office, Lee Weidlien, to San Francisco, and Jack E. McKay to the Houston sales office.

McKay

Weidlien

DeFlon, engineer with Fluor since 1941, recently returned from London where he has been negotiating with Head Wrightson Processes Ltd. for the sale of Fluor products in England and other European countries.

DeFlon

Weidlien is a graduate of the University of Kansas. He has been engineer with the firm from 1943 to 1948 and has recently rejoined.

McKay, who joined Fluor in 1942, has served as advertising and public relations manager in the main plant at Los Angeles and as a sales engineer in Kansas City and Los Angeles. He is a graduate of the University of Oklahoma.

Johns-Manville Promotes Industrial Products Managers

T. J. Roberts of Atlanta, Ga., is new Houston district manager of Johns-Manville Corporation's Industrial Products Division, and Henry G. Palmer is Atlanta district manager. Palmer formerly served as assistant manager.

A graduate of Cornell University in civil engineering, Roberts began with Johns-Manville in 1925, in New York. In his new position, he will supervise sales of industrial products in Texas and parts of Louisiana, Arkansas and Oklahoma.

Palmer is a graduate of the University of Georgia and later attended Georgia Tech where he was awarded an advanced degree in civil engineering. He joined Johns-Manville in 1936 as a sales engineer in the Atlanta district. Palmer will supervise sales of industrial products in Georgia, Florida, Alabama, South Carolina and parts of Kentucky, Mississippi, North Carolina, Tennessee and Virginia.

Joins Key's New York Staff

Key Company, East St. Louis, Ill., has transferred Robert D. Burkhart to the New York office. Burkhart has been with the company for 16 years, and previously served as assistant to the chief engineer.

Wing Consolidates Offices

L. J. Wing Manufacturing Company has consolidated its three separate factories in Newark, N. J., and general offices in New York into a single factory building at Vreeland Mills Road, Linden, N. J., to effect closer and more efficient interdepart-

HOW TO COMBAT COOLING WATER TROUBLE

Corrosion is but one enemy of cooling water systems. In addition, scale, slime and algae add to the trouble. Yet, no cooling water system need be subject to costly shutdown because of corrosion, scale or biological troubles, provided a proper program of chemical treatment and control is followed.

For over two decades BETZ has provided engineering guidance and developed control procedures for the correction and prevention of water difficulties. If the results you are presently obtaining are not fully satisfactory, our nationwide staff of engineers welcome the opportunity to discuss your water problems.

W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa.

BETZ

COOLING WATER CONDITIONING • BOILER WATER CONDITIONING

mental cooperation. An office at 154 West 14th Street, New York, will be maintained to handle New York City sales.

Transferred to Dallas Office

W. F. Strong has been transferred to General Electric Company's Dallas office as an application engineer for the southwestern district. A graduate of Tulsa University and Oklahoma University, Strong started working for GE in 1940 as a student engineer on the test course in Schenectady. Since graduating he spent four years on magnetic and electronic control design. He has worked as an industrial application engineer on industrial power distribution, resistance welding, machining, and electrostatic precipitation.

Bigelow-Liptak Establishes New District Sales Offices

Charles F. Koos, in the newly established Tulsa office, will represent Oklahoma, New Mexico and a portion of Texas and Arkansas in the sale of Bigelow-Liptak Corporation's industrial furnace enclosures and industrial insulation. Supervising the Portland, Ore., office is J. A. Schruefer, who will cover southern Washington and Oregon. Armin O. Schleiffarth, representative at St. Louis, with his two sons, Donald and Armin D., will cover eastern Missouri and southern Illinois.

Warner Lewis Agent Named

Richard Morton, registered chemical engineer, New York, is newly appointed representative of Warner Lewis Company, Tulsa, manufacturers of combination water separators, micron filters, etc. Morton will have headquarters at 30 Church Street, New York 7.

J&L Steel Company Appoints Manager of Pail Sales

Dave Merrill has been named manager of pail sales, J&L Steel Barrel Company, subsidiary of Jones & Laughlin Steel Corporation. Merrill was formerly assistant to director of sales for Crown Can Company, and previously with American Can Company. In his new position he will head sales for J&L Steel Barrel's recently acquired steel pail producing facilities of the American Can Company in Toledo, Ohio; Chicago, Ill.; and Jersey City, N. J.

Merrill

The Jersey City equipment is currently being combined with the company's barrel producing plant at Bayonne, N. J. The Chicago equipment is being moved to Kansas City, Kan., where it will be consolidated with barrel production in a newly purchased plant.

Division Manager of New Shand & Jurs Tulsa Office

Shand & Jurs Company, Berkeley, Calif., has opened a new factory branch office in Tulsa with Breen Ringland as division manager. He will serve as consultant on engineering, manufacturing, field and operational problems of petroleum companies in Oklahoma, Kansas, Arkansas and parts of Missouri.

Ringland

Ringland joined the Shand & Jurs sales organization in 1946 and later was transferred to the Chicago office where he was subsequently assistant manager. Before his Shand & Jurs employment, he served as inspector of petroleum storage tanks and storage tank fittings.

Hooker Product Supervisor

John P. Edwards has been named supervisor of product application by Hooker Electrochemical Company. He will coordinate activities of research and sales. Edwards, a chemical engineer, was graduated from the University of Minnesota in 1940, and since coming to Hooker that year, has been associated with the process study group and more recently with the sales development department.

Pacific Tube President

Edgar H. Lloyd has been elected president of Pacific Tube Company, Los Angeles. Lloyd has served as superintendent since 1943 and for the past two years was vice president in charge of operations. Before becoming associated with Pacific Tube Lloyd for 12 years was directly connected with the cold drawn seamless tube industry. He is a

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The Hose With a Reputation...for Outstanding Safety and Durability

From 80 years of hose-making experience, Goodall has built into "INFERNO" the high factor of safety and the qualities insuring extra long service life that make this hose so desirable and economical for every refinery steam service.

The tube offers remarkable resistance to hardening and cracking under high temperatures. Tightly braided galvanized steel wires reinforce the rugged, heat-resistant carcass. The tough red cover withstands severest abrasive wear and all conditions of weather.

Recommended for pressures up to 200 lbs. and temperatures to 400° F. Available from stock in all sizes from ½" to 2" I. D., in maximum lengths of 50 feet.

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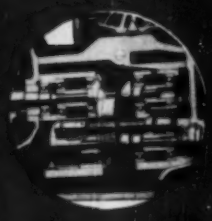

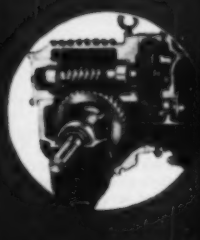

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Master Motors, available in thousands on thousands of combinations of types and ratings, permit you to use a power drive on each job that's just right . . . a power drive that will add greatly to the compactness, appearance, and economy of each of your applications.

Use Master Motors to increase the salability of your motor-driven products . . . improve the economy and productivity of your plant equipment. They're the horsesense way to use horsepower.

THE MASTER ELECTRIC COMPANY

DAYTON 1, OHIO

which adds greatly to the economy, safety, compactness and appearance of the finished product.

graduate of Notre Dame University with a bachelor of science degree in chemical engineering.

General Controls Addition

Construction has been started on a $100,000 plant addition at General Controls Company's Glendale, Calif., plant. President W. A. Ray said that the new facilities will be for the assembly of the company's automatic pressure, temperature, level and flow controls. The addition brings the manufacturing space to a total of 200,000 square feet.

Brady Milwaukee Office Moved

W. H. Brady Company has moved Milwaukee offices from 808 North Third Street to 204 West Washington Street 4.

New Crane Valve Distributor

Vinson Supply Company has been appointed distributor for Crane Company's line of cast steel valves, gates and malleable fittings which will be stocked in Vinson's major warehouses at Tulsa, Dallas and Odessa.

Vinson also handles National Tube Company pipe and tube, Ladish welding fittings and flanges, Fisher control equipment, Nordstrom plug valves, and Chase brass and condenser tubes.

Babcock & Wilcox Appointed

C. B. Marshall, Jr., has been named to the sales force of the Chicago district sales office of The Babcock & Wilcox Tube Company. A graduate in chemical engineering from Washington and Jefferson College, Washington, Pa. Marshall has been in the general sales office of the B&W welded tube division at Alliance, Ohio, since 1944 and until recently was manager of the general sales office. Previously he was with Hall Laboratories, Inc., Pittsburgh, Pa., and was later connected with the National Works of National Tube Company at McKeesport, Pa.

Cameron Sales Picks Managers For Its New Valve Division

Harris

Bliss

Cameron Iron Works, Houston, has appointed Jack Harris and Ames Bliss sales managers of the company's newly created "LP" valve division.

For the past several years Harris has been with the Cameron engineering and sales departments, coming to Cameron from J. S. Abercrombie-Harrison Oil Company refinery at Sweeny, Texas, where he was a department head. Previously he was foreman in Gulf Oil Company refinery at Port Arthur after receiving a BS degree in chemical engineering from Rice Institute in 1935. Harris has served as development engineer on the new Cameron lift-plug valve and other new equipment.

Bliss, a graduate of Massachusetts Institute of Technology, was a member of the Cameron engineering staff and has done development work on the new Cameron lift-plug valve.

Solvay Sales Executive

Harold F. Merritt has been appointed executive vice president of activities of the Solvay sales division, Allied Chemical & Dye Corporation. Merritt started in 1913 with Wing & Evans, Inc., and, with the exception of two years during World War I, has served continuously with that company and the Solvay sales organization which succeeded it. He has been a vice president of Solvay sales for 19 years.

Merritt

Kinney New Chicago Address

Kinney Manufacturing Company, Boston, has moved its Chicago branch office from the Socony-Vacuum Building, 59 East Van Buren Street, to Room 1313, People's Gas Building, 122 South Michigan Avenue. The branch office continues in charge of Alfred J. Munday who has been with Kinney since 1917.

Wilson Buys Bolt Business

Through purchase of the safety release pressure bolt business of Dunton-Cham-

Over many years of service

HAERING ORGANIC GLUCOSATES*

have an unexcelled record of performance in controlling

SCALE, CORROSION AND ALGAE

in the PETROLEUM INDUSTRY

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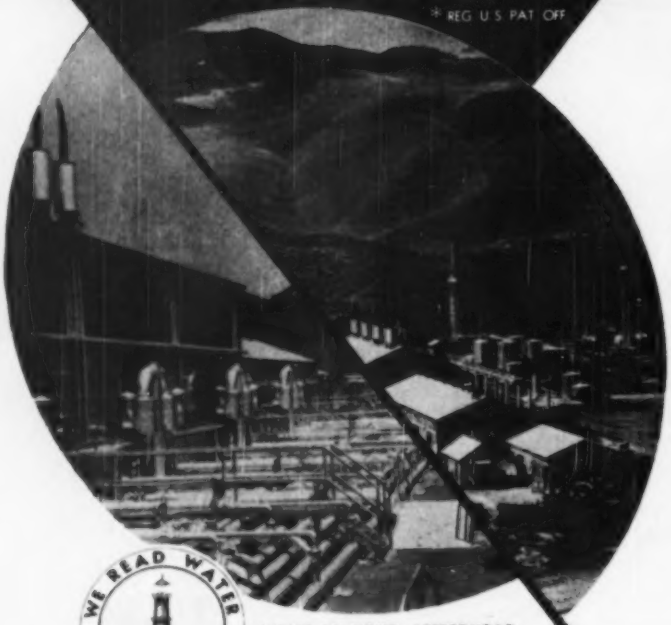

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WRITE ON YOUR LETTERHEAD FOR SPECIAL LITERATURE

D. W. HAERING & CO., Inc.

Established 1931

General Offices P. O. Box 6037 San Antonio, Texas

Chicago Office, 205 West Wacker Drive

bers Manufacturers, New York, Thomas C. Wilson, Inc., will acquire the Dunton-Chambers inventory, engineering data, and sole manufacturing rights. The bolt business will be combined with Wilson's line of tube expanders and tube cleaners which will be distributed and marketed under the trade name of Wilson-Dunton.

Supervisor and Sales Engineer Named for Rockwell Districts

Leisenring

Barnett

Rockwell Manufacturing Company has announced appointments of Orville W. Barnett as gas product sales supervisor in the Tulsa district and John L. Leisenring as sales engineer for the southern two-thirds of Indiana and several counties in the extreme southern part of Illinois.

Barnett, who will continue to maintain his headquarters in Dallas, will assist the general sales force in gas product sales and service products. He has been with Rockwell since his graduation from the University of Oklahoma in 1934 and has since served in Nordstrom field work in Oklahoma, Rodessa and Shreveport, La., areas.

Leisenring, who attended the Dean School of Business at Wyoming Seminary in Kingston, Pa., has for the past year and a half been assigned to Fluor industrial accounts in the Chicago area. He will handle the line of valves, gas meters and regulators. First employed with the firm in 1945 as a service engineer in the Chicago district, he handled the field maintenance of all products.

Assistant Sales Manager Harnischfeger Welding

Harnischfeger Corporation, Milwaukee, has appointed A. G. Hendrickson as assistant sales manager of the P&H welding division. Hendrickson has served as welding engineer in the Milwaukee and the Minneapolis territories and as Farm Bureau consultant on welding. He will be assistant to Melvin O. Monsler who was recently promoted from assistant to sales manager. P&H products in the welding field include P&H AC and DC arc welders, welding electrodes, welding positioners and welding production control systems.

Hendrickson

Heads Control Devices

John B. Moxness has been appointed industry engineer in charge of sales pro-

NOT 1 CENT for Repair Parts for 444 Nicholson Steam Traps Installed in 2 Years

Here is added evidence of the remarkably low maintenance costs of Nicholson expansion steam traps. In the 2 years Bradshaw & Co. have been distributing them in the Pittsburgh area they have installed 444 traps. But they have received not one order for repair parts. And examination of traps in continuous drainage service for at least 18 months, at steam pressures to 250 lbs., showed no sign of valve cutting.

Pressure: 0 to 250 lbs. without change of valve or seat. Length: 18" to 40". 2 types: thermostatic, continuous flow.

Easily Installed, Low Cost

Because valve is easily adjusted to pass condensate at any temperature below 212° F., these traps are also widely used for regulating temperature of equipment.

FOR ALL EQUIPMENT Using Steam or Hot Water

Absorption Stills	Petrolatum Tanks
Agitators	Pipe Coils
Evaporators	Radiators
Gas Holders	Rebollers
Heat Exchangers	Steam Stills
Heavy Oil Tanks	Tar Tanks
Kettles	Wax Tanks

CATALOG 448 or see Sweet's

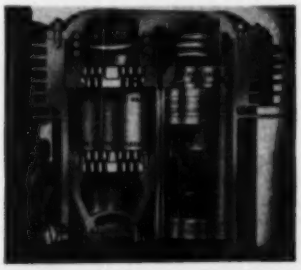
W. H. NICHOLSON & CO., 207 Oregon St., Wilkes-Barre, Pa.

NO OTHER COMPRESSOR VALVE OFFERS YOU ALL OF THESE ADVANTAGES

1. **LARGER GAS PASSAGE AREA** — From 20% to 100% increased valve area handles more and colder gas; a colder therefore denser gas costs less to compress.
2. **LARGER VALVE AREA** — Raises back end lowers head pressure, consequently reduces compression ratio—saving more power.
3. **NOISELESS** — Smooth running—with less power—at higher speeds without overheating.
4. **SAFE** — No castings used—therefore no invisible blow-holes or cracks which insures safety of operation. Gas passages drilled, slotted and milled smooth—hence less friction.
5. **LONG LIFE** — Made to the highest standard of workmanship—on special machines—by craftsmen—in a modern and well equipped shop—designed to give long life under the severest conditions.

LET US SHOW YOU WHAT VOSS VALVES CAN DO FOR YOU

We will be glad to submit estimates if you will send us the name, bore, stroke and speed of your air, gas, or ammonia compressors of any type or size.



VOSS LONG LIFE COMPRESSOR VALVES

VOSS VALVES are indispensable for use where loads are heaviest—where safety and reliability are paramount. They run smoothly—with less power—at higher speeds—without overheating. You can replace your present valves with VOSS VALVES without any change in your compressor.

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RATES for Classified Ads are $1 per column inch. Minimum size one column inch. In smallest type size, figure 50 words per inch. **Situations Wanted $4 per column inch. All classified ads payable in advance.** Ten percent discount if three or more insertions are ordered at same time. COPY DEADLINE is 25th of month preceding date of issue. Send copy and checks to: Classified Ad Department, Petroleum Refiner, P. O. Box 2608, Houston 1, Texas.

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Petroleum Engineer, experienced in production and drilling. Gulf Coast area. Capable of directing office, preferably one with multi-engine pilot license. Salary open. Write Box 167-R, c/o Petroleum Refiner, Houston, Texas.

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Ethylene production. Chemical engineers with practical experience wanted on consulting or full time basis. Give details of pertinent experience. Box 188-R, c/o Petroleum Refiner.

motion of control devices for Brown Instruments division of Minneapolis-Honeywell Regulator Company.

United States Steel Names Executive of Engineering

F. R. Burnette, appointed assistant vice president, engineering of United States Steel Corporation of Delaware, will have special duties in connection with the future construction programs of United States Steel Corporation. He was graduated from Ohio Northern University in 1910 with a degree in civil engineering. Before going to college he had been employed by Carnegie-Illinois Steel Corporation as a laborer, machine operator and foreman, and after graduation returned to U. S. Steel as an inspector and estimator.

Burnette

Since 1912 he has served with Aluminum Company of France and Aluminum Company of America at Baden, N. C., American Steel and Wire Company at Cleveland, and Carnegie-Illinois.

Kennedy Valve Buys Semler

Purchase of Semler Company, Jeannette, Pa., by The Kennedy Valve Manufacturing Company, Elmira, N. Y., has resulted in the addition of Semler's cast-iron fittings to the present Kennedy line of malleable iron and bronze fittings. Manufacturing operations will be continued at the Jeannette plant.

New officers of the company are Charles F. Kennedy, president; J. Lawrence Kennedy and Howard P. Semler, vice presidents; and Thomas S. Turkington, controller.

Production Equipment Location

Production Equipment Company, Inc., a subsidiary of The Buda Company, is located at its new address, 2529 Chambers Street, Vernon, Calif. Old site was in Los Angeles.

Assigned New England Area

The Cambridge Wire Cloth Company announces J. G. Peters' assignment to the New England territory. Peters will maintain offices at 141 Milk Street, Boston, and 551 Fifth Avenue, New York.

Physicist to New York Office

National Technical Laboratories, manufacturers of Beckman instruments, has added George D. Butler to the New York office. As a physicist in instrumentation research at the Calco Chemical Division of American Cyanamid Company, Butler has had experience in the development and use of pH meters, spectrophotometers and related scientific instruments. He also was an engineer for Carl L. Norden Company during the war, and previously was with Bendix Aviation as a technical representative.

Butler

Laclede-Christy to Acquire Chicago Firm's Common Stock

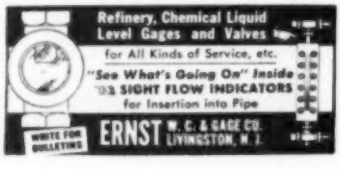
Donald N. Watkins, president, has announced that Laclede-Christy Company will acquire the assets and liabilities of Chicago Retort and Fire Brick Company of Ottawa, Ill., in exchange for common stock.

The Chicago company was organized in 1887 and since then has manufactured and sold fire brick and high-temperature cements. It operates a large plant at Ottawa which recently has been modernized including the construction of a new tunnel kiln unit.

Laclede-Christy has its executive offices in St. Louis and its general sales office in Pittsburgh. Other plants are in Missouri, Ohio, Pennsylvania, California, Alabama, and Colorado.

Vinson Expands Warehouse

To maintain a stock of pipe, valves, fittings and controls, Vinson Supply Company has completed a $75,000 warehouse at Boston and Cameron Streets, Tulsa. The new building, which is 70 feet wide and 150 feet long, is equipped with a large overhead crane to move pipe directly from the warehouse to railroad cars on a railroad spur. A complete range of pipe sizes from ⅛ to 24 inches, with wall thickness up to one inch, will be handled.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'93 SIGHT FLOW INDICATORS
for Insertion into Pipe
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ERNST GAGE CO.
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For Positive Leak Prevention In Refinery Use . . . . . It's

RECTORSEAL

Rectorseal is a proved leak preventer . . . a 12-year favorite in the production and pipe line divisions of the industry.

It's easy to apply, economical to use. It's impervious to petroleum and its fractions—insoluble in oil and water. It's ideal for use on LP gas, light hydrocarbon, natural gasoline, and meter connections. It maintains its plastic elasticity for the life of the connection.

Available in pints, ½ pints and ¼ pints, quarts and gallon sizes.

Ask your supply store or write direct—

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Manufactured by
RECTOR WELL EQUIPMENT CO., INC.
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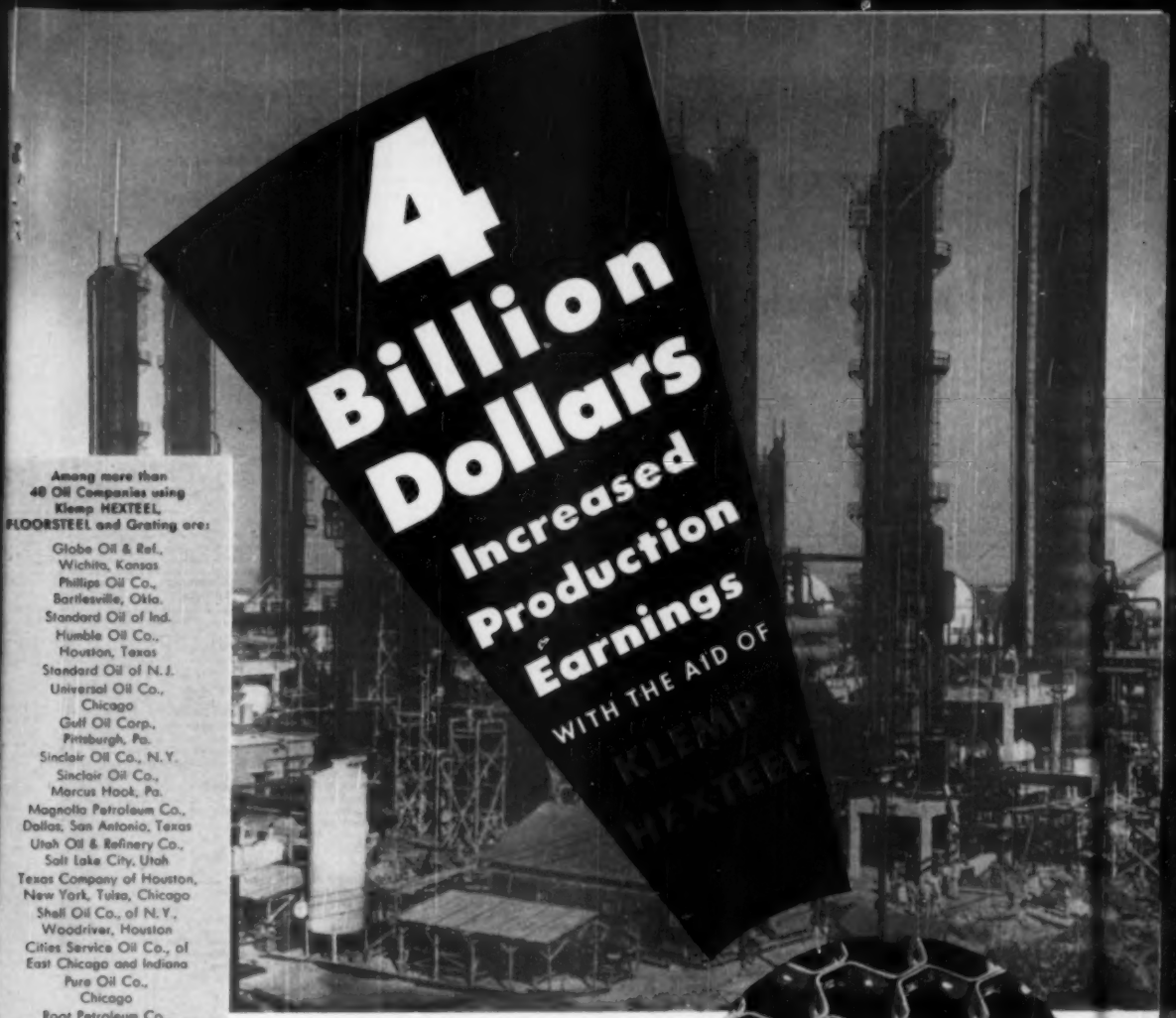
MAKING THE OIL INDUSTRY SAFER



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Standard Oil of Ind.
Humble Oil Co., Houston, Texas
Standard Oil of N. J.
Universal Oil Co., Chicago
Gulf Oil Corp., Pittsburgh, Pa.
Sinclair Oil Co., N. Y.
Sinclair Oil Co., Marcus Hook, Pa.
Magnolia Petroleum Co., Dallas, San Antonio, Texas
Utah Oil & Refinery Co., Salt Lake City, Utah
Texas Company of Houston, New York, Tulsa, Chicago
Shell Oil Co., of N. Y., Woodriver, Houston
Cities Service Oil Co., of East Chicago and Indiana
Pure Oil Co., Chicago
Root Petroleum Co., El Dorado, Ark.
Imperial Oil Co., Toronto, Ontario, Canada
Cit-Con Oil Corp., N. Y.
Elk Refining Co. Charleston, W. Va.
Republic Oil Refining Co., Texas City, Texas
Atlantic Refining Co., Philadelphia, Pa.
Sun Oil Co., Philadelphia and Toledo, Ohio

KLEMP
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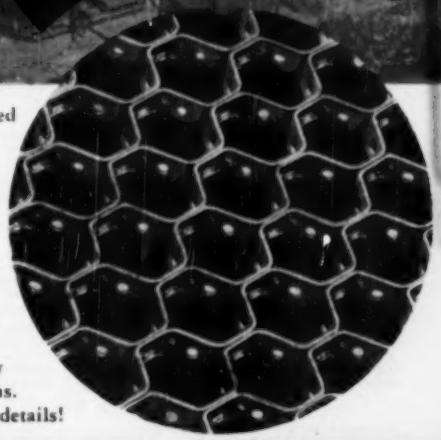
HEXTEEL



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in the April, 1950, issue of

Petroleum Refiner

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Wyatt Metal & Boiler Works III Cover

Y

*Yarnall-Waring Co. II Cover

The above quotation is from a letter by the Struthers Wells Corporation, Warren, Pa., accompanying the picture shown above. The picture shows two boiler feedwater heaters, intermediate and low-pressure, made by Struthers Wells for the generating station of a large public utility. These two tube bundles contain Revere deoxidized copper tubes, made to ASTM Specification B-111. One uses ¾" O.D. x #18BWG tube, while the other has tube ⅝" O.D. x #18 BWG. It will be noted that some of these tubes are bent to a small radius; superior bending quality is one of the features of Revere Copper Tube supplied for such purposes . . . In addition to copper tube, Revere offers for condenser and heat-exchanger service tubes in all the customary copper alloys, such as Admiralty Metal, Muntz Metal, the brasses and bronzes, and the cupro-nickels . . . For true economy it is important to select the correct size and alloy to meet actual conditions of use. Revere will gladly collaborate with you in such selection, whether for new equipment, or for re-tubing.

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COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

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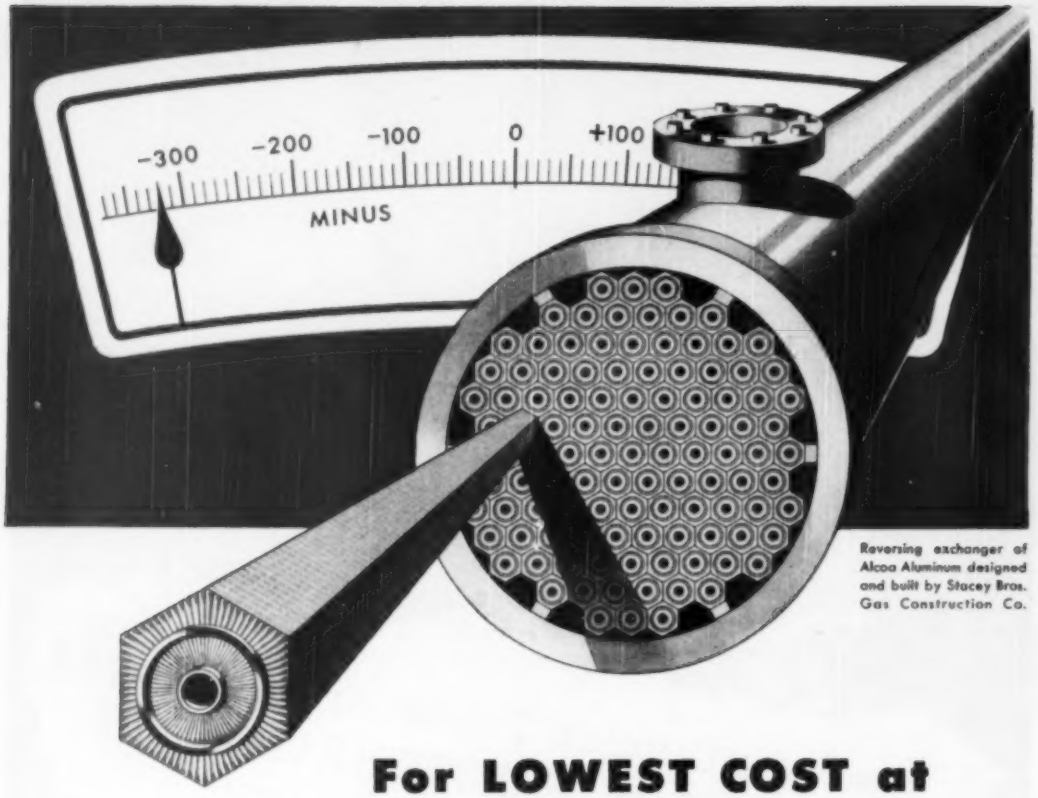

Reversing exchanger of Alcoa Aluminum designed and built by Stacey Bros. Gas Construction Co.

For LOWEST COST at minus 320° F

Take your choice of metals suitable for sub-zero process equipment . . . copper, nickel, stainless, aluminum. All stay strong as temperatures drop. All are fabricated by standard tools and methods.

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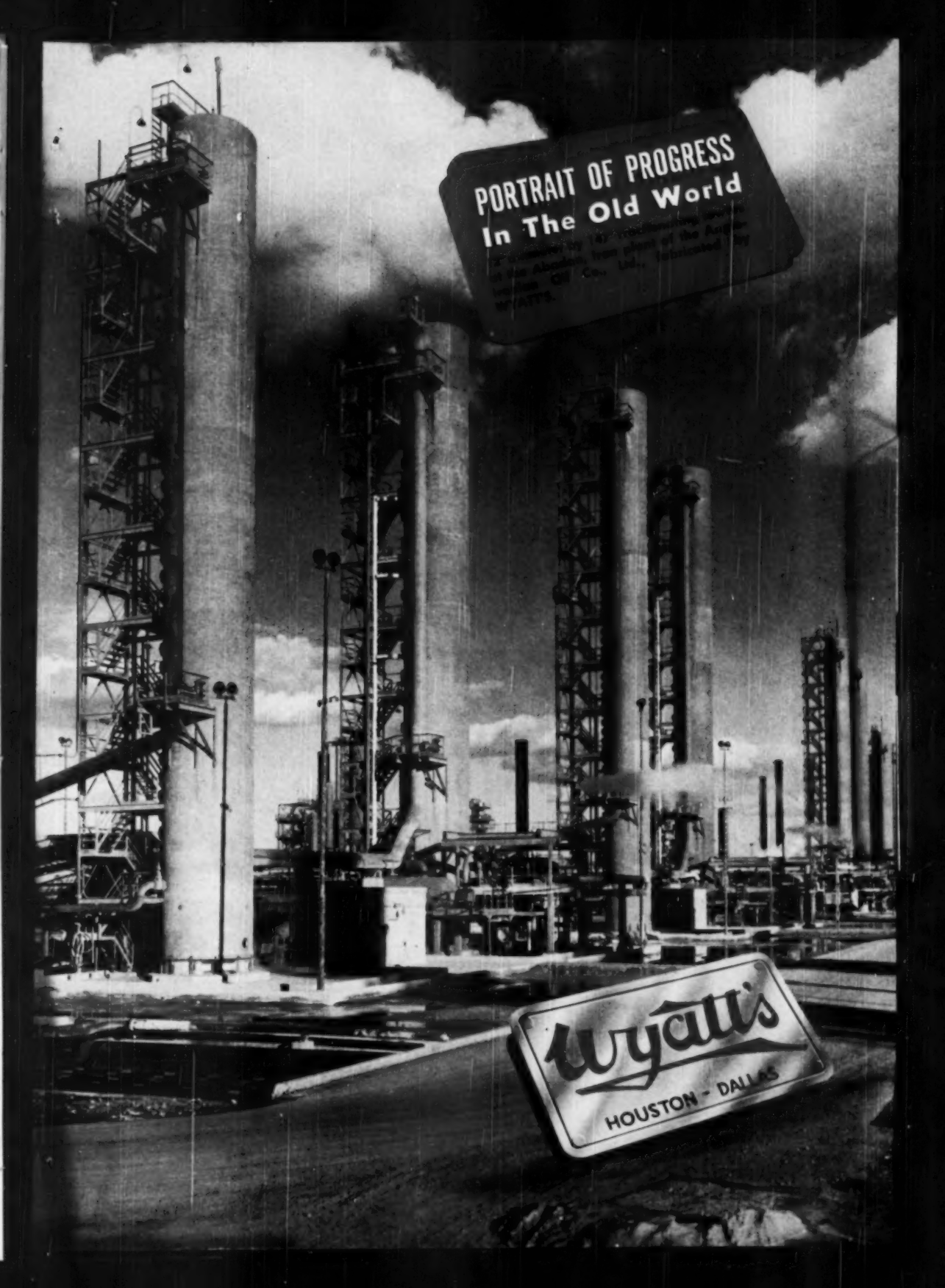
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Wyatt's
HOUSTON - DALLAS

'CUSHION-CLOSING' *ends* SHOCK AND HAMMER

Time-Tested McDonald Valves Save Costly Line Equipment

Thousands of users will tell you the McDonald Slo-Self Closing Loading Line Valves are the one positive, permanent way of eliminating the destructive shock and hammer imparted to pressure lines when ordinary valves are suddenly closed . . . These time-tested valves *cannot* "bang shut" because the valve plunger is hydraulically controlled . . . This is a time to guard against costly damage to expensive line equipment—a time to make sure that McDonald Slo-Self Closing Valves are installed wherever loading is done under high pressure . . . Ask for full details.

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"The Home of the Swing Joint"
DUBUQUE, IOWA
There's a McDonald Branch or Distributor Near You

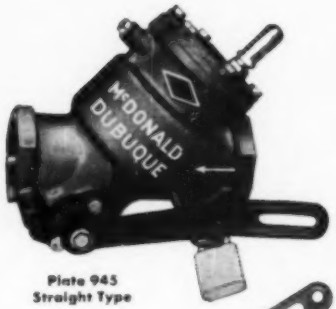

Plate 945
Straight Type

Plate 967
Adjustable Handle

Plate 956
Angle Type

McDonald Slo-Self Closing Loading Line Valves feature cushion closing, easy opening, full flow. Adjustable to operating pressures. Available in hold-open and stay-open types. All-bronze except for malleable iron handle and steel roller. Sizes: 2", 2½", 3".

For Low-Pressure or Gravity Loading...The McDonald Self-Closing Loading Line Valve

A leak-proof, full-flow valve designed to give a cushion closing effect. Elimination of "belly" at valve bottom provides a straight waterway and increases volume. High-grade bronze body—malleable iron cam and handle—steel stem. Sizes 2", 2½", 3".

Plate 902

Plate 988

McDONALD VACUUM BREAKER—for loading lines. Permits automatic and instant draining of fill pipes. Leak-proof construction. All-bronze except for composition disc. Size ⅜".

McDONALD